SCIENCE

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FRIDAY, NOVEMBER 6, 1896.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

GEORGE BROWN GOODE.

THE grievous loss to the scientific world of Dr. George Brown Goode has already been recorded in SCIENCE. At the request of the editor I now add a notice of some of the prominent features of his biography and an estimate of his scientific works.

For the biographical portion (I.) I am indebted to Dr. Marcus Benjamin.

I.

In the untimely death of Dr. G. Brown Goode, American science mourns the loss of one of its most distinguished representatives. No more, and equally no less, can be said of the man whose best years seemed as yet unlived, when he was suddenly stricken with pneumonia and died a victim of that cruel disease at his home on Lanier Heights, in Washington City, on Sunday evening, September 6.

George Brown Goode was born in New-Albany, Ind., on February 13, 1851. His ancestry was colonial and he traced with pride his paternal line to John Goode, of Varina Parish, in Virginia, who was a soldier under Bacon in 1676, in the first armed uprising of Americans against the oppressions of royal authority. On his mother's side he was descended from the Crane family of New Jersey, of which Stephen Crane was one of the most conspicuous representatives of that colony in the events that led to the war of the Revolution.

As a boy he moved with his parents from Indiana and settled in New York. He early showed a fondness for natural history and it was his pride to recall how this boyish fancy was confirmed by his reading the reports of the Smithsonian Institution, a set of which formed part of the family library. As he grew older he was prepared for college and in time entered Wesleyan University, in Middletown, Conn., where he was graduated in 1870, being one of the youngest members of his class. During his college career his predilection for natural history studies was marked, and he was recognized as 'a man exceptionally promising for work' in that direction. During the first part of the college year of 1870–71, he was entered as a graduate student in Harvard University and there came under the influence of the elder Agassiz. Meanwhile, Orange Judd Hall, a building devoted to natural sciences, was erected in Middletown through the munificence of the gentleman whose name it bears, and young Goode was promptly called by the faculty of his *alma mater* to arrange and display the natural history collections of the university in such a shape as to make them worthy the name of a museum. As the work proceeded it became manifest that he had found his vocation and in the task of arranging the museum of Wesleyan University he began to display that remarkable ability for museum administration, that has since found so worthy a field in the National Museum in Washington.

His scientific studies, however, were not neglected and he sought to increase his knowledge by becoming acquainted with the workings of the United States Fish Commission. He met Prof. Baird, in the summer of 1873, in Portland, Me., during the meeting there of the American Association for the Advancement of Science. It proved a fortunate meeting for both men. The elder naturalist was at once impressed by the enthusiasm of the younger man and invited him to become an assistant in the service of the commission. Regularly thereafter from 1873 until 1880 Goode was a member of one of the summer parties and later served in other capacities until, on the death of Prof. Baird, he was at once called to the place of Fish Commissioner, which high office, notwithstanding the many other duties pressing on him, he consented to fill without salary until the law could be amended so as to make the office independent of the National Museum.

In connection with the Fish Commission it is proper to mention the active part that he took in behalf of the United States at the Halifax Commission, which had to do with settling the fishery relations between this country and Canada. Nor should the fact that he had charge of the work for the Fishery Division of the tenth census be omitted.

The ability displayed by Goode during his first season with the Fish Commission soon led to closer ties between himself and Prof. Baird, for the latter invited him to join the scientific staff of the National Museum. In 1873 he became regularly connected with that institution, and for a time received as his only compensation specimens of natural history which he in turn presented to the Museum in Middletown, where he retained his connection until 1877. From assistant curator in the National Museum he was advanced to the office of assistant director, and in 1887 he was made, on the recommendation of Secretary Baird, assistant secretary of the Smithsonian Institution in charge of the National Museum, which office he continued to fill until his death. The genius that he first showed in the arrangement of the collections in Wesleyan University broadened and developed as he grew older until it was universally conceded that he had no superior in the world among museum administrators. His writings on

this subject are accepted authorities, and include the well-known monograph 'Museums of the Future' (1890) and 'Principles of Museum Administrations' (1895) to which should be added his annual reports as assistant secretary during the years of his incumbency of that post.

The ability for museum administration with which he was so liberally gifted, led naturally to his active participation in what has come to be known among government officials as 'Exposition work.' Prof. Baird intrusted him with the installation of the Smithsonian exhibits at the Centennial Exhibition held in Philadelphia in 1876, and he served as U. S. Commissioner to the Fisheries Exhibitions that were held in Berlin in 1880 and in London in 1883. The minor expositions held in New Orleans, in Cincinnati, in Louisville, and more recently in Atlanta, contained his name on the Government Boards, and he was prominent in the management of the Government Exhibit at the World's Columbian Exposition held in Chicago during 1893, for which he also prepared a 'Plan of Classification' that formed the basis of the arrangement subsequently adopted by the officials for the installation of the exhibits. He had also to do with the Columbian Historical Exposition held in Madrid, Spain, during the winter months of 1892-93, and, after the death of the Commissioner General, acted in that capacity. His services in that connection gained for him the Order of Isabella the Catholic with the grade of Commander.

In this hasty summary of his life, only the more important of his many interests can be referred to; at least, mention must be made of his great fondness for matters pertaining to American history. His study of genealogy began when he was but a boy and led to his publication of the record of his family under the title of 'Our Virginia Cousins.' Soon after leaving college he was made one of the editors of the *Alumni Record*, of Wesleyan University, which is among the best of the 'college books.' He was one of the founders of the American Historical Association and contributed to its proceedings in 1890 his valuable paper on 'The Origin of the National Scientific and Educational Institutions of the United States.' He was also a member of the newly organized Southern Historical Society. Much of his leisure during the past two summers was given up to the preparation of the material that is to be used in the 'Half Century Book of the Smithsonian Institution,' which was his project, and which, when published, will be a monument to his knowledge of science in this country during the half century of the existence of the Smithsonian Institution.

Dr. Goode was one of the founders of the District of Columbia Society of the Sons of the American Revolution, becoming from the beginning one of its officers and since 1894 its president. He was a vice-president of the Society of the Sons of the Revolution and a lieutenant-governor of the Society of Colonial Wars.

In scientific societies he was equally conspicuous. In Washington he was a founder in several, and was a past president of the Philosophical Society and of the Biological Society, to both of which he contributed, on retiring, addresses that treated of the history of American science. Other societies both in this country and abroad were honored in having his name on their rolls. Among these were the Zoological Society of London and the National Academy of Sciences in the United States, to which he was elected in 1888. He was elected a member of the American Association for the Advancement of Science in 1873, and at its meeting held in Buffalo during August of this year he was chosen a vice-president for the section on zoology.

The honorary degree of LL. D. was

conferred upon him by Wesleyan University and the degree of Ph. D. by Indiana University.

Incidental mention has been made of some of his larger works, but a complete bibliography of his papers would include hundreds of titles, so indefatigable had he been in the too few years of his busy life. He has gone, but his influence will remain so long as the National Museum shall exist, and his memory will ever be cherished by all who had learned to love and respect him.

II.

Dr. Goode's first contribution to science was published in 1871 in his twenty-first year and incorporated in a note of the editors of the *American Naturalist* (v. 489); it merely recorded the occurrence of 'The bill fish in fresh water' in the Connecticut river.

His first memoir giving any indication of his range of reading and ability in the systematization of facts was published two years later (1873) "On the question 'do snakes swallow their young'"*. Through an advertisement in *The American Agriculturist*, a weekly journal with a large circulation in rural districts, he obtained numerous answers to the question and thus was enabled to supplement the records previously published by original accounts. The result of a critical survey of the data at command compelled him to admit that there was a good foundation in fact for the popular belief, and that certain viviparous snakes do really admit their young, who instinctively seek refuge in the interior of their mother when danger threatens and are liberated when it has passed.†

A 'Catalogue of the Fishes of the Bermudas,'* published in 1876, furnished additional evidence of knowledge of the literature of his subject and ability to use it to advantage in the discussion of mooted questions and it also evinced his power of observation.

In the same year, 1876, appeared another work which, to a still greater degree, rendered manifest those same mental characteristics. The work was only a catalogue, but perhaps from no other publication can some intellectual qualities be so readily and correctly gauged by a competent judge as an elaborate catalogue. Powers of analysis and synthesis, and the ability to weigh the relative values of the material at hand, may make a 'mere catalogue' a valuable epitome of a collection and of a science. Such a production was the 'Classification of the Collection to illustrate the Animal Resources of the United States,'† a work of 126 pages; three years later this catalogue served as the basis for and was elaborated and expanded into a large 'Catalogue of the Collection to illustrate the Animal Resources and the Fisher-

* On the Question, "Do Snakes swallow their Young?" In Proc. Amer. Assoc. Advan. Sci. 1873 (1874), pp. 176–185. Also separately, repaged, 12 pp.

† Mr. H. Tootal Broadhurst has collected a number of original observations in a recently published pamphlet confirming the allegation that mother snakes may receive their young within their mouths. Mr. Broadhurst was apparently unacquainted with Dr. Goode's article; his own is entitled, 'Do the Young of Vipers take Refuge Down the Throat of the Mother in cases of Sudden Surprise or Danger?' (Dumfries, July, 1895. 8vo, 29 pp.)

* Catalogue of the Fishes of the Bermudas, Based chiefly on the collectings of the United States National Museum. . . Washington: Government Printing Office. 1876. [8° pp. (2) 1–82.—Bulletin United States National Museum. No. 5.]

† International Exhibition, 1876. Board in Behalf of United States Executive Departments. Classification of the Collection to illustrate the Animal Resources of the United States. A list of substances derived from the animal kingdom, with synopsis of the useful and injurious animals and a classification of the methods of capture and utilization. . . Washington: Government Printing Office. 1876. [8° pp. 126.—A second edition with supplementary title as Bulletin No. 6, United States National Museum.]

ies of the United States,'* a volume of 351 pages. These catalogues were for the tentative and adopted arrangement of material exhibited by the Smithsonian Institution and the United States Fish Commission at the 'International Exhibition, 1876.'

It was the ability that was manifested in these catalogues and the work incidental to their preparation that especially arrested the attention of Prof. Baird and marked the author as one well adapted for the direction of a great museum. For signal success in such direction special qualifications are requisite. Only some of them are a mind well trained in analytical as well as synthetic methods, an artistic sense, critical ability, and multifarious knowledge, but above all the knowledge of men and how to deal with them. Perhaps no one has ever combined, in more harmonious proportions, such qualifications than G. Brown Goode. In him the National Museum of the United States and the world at large have lost one of the greatest of museum administrators.

As a naturalist, the attention of Dr. Goode was especially directed to and even concentrated on the fishes. His memoirs, contributed mostly to the Proceedings of the United States National Museum, were numerous and chiefly descriptive of new species. (For many of these he had, as a collaborator, Dr. Tarleton Bean, then the curator of fishes of the United States National Museum.) Some of the memoirs, however, dealt with special groups, as the Menhaden (1879), Ostraciontidae (1880), Carangidae (1881), the Sword-fishes (1881), and the Eel (1882). His monograph of the Menhaden (*Brevoortia tyrannus*), contributed originally to the Report of the United States Commissioner of Fisheries* and then published as a separate work†—a large volume of nearly 550 pages and with 30 plates—is a model of critical treatment of information collected from all quarters. But his most important contributions were published as official Government reports and were the results of investigations especially undertaken for such reports. Especially noteworthy were the volumes comprising the results of the census of 1880.

The 1880 census was planned and carried out on an unusual scale. For the Fisheries, the U. S. Commission of Fish and Fisheries cooperated and Dr. Goode had general charge of the entire work. The assistants and special agents were consequently selected with judgment and the results were very valuable. The huge mass of statistics was digested and condensed in seven large quarto volumes representing five sections separately devoted to special branches of the subject.‡ Dr. Goode's cares were mainly

* International Exhibition, 1876. Catalogue of the Collection to illustrate the Animal Resources and the Fisheries of the United States, exhibited at Philadelphia in 1876 by the Smithsonian Institution and the United States Fish Commission, and forming a part of the United States National Museum. . . Washington: Government Printing Office. 1879. [8° pp. 351. (1)—*Bulletin United States National Museum, No. 14.*]

* The Natural and Economical History of the American Menhaden. In Report United States Commission of Fish and Fisheries, Part v., 1879, Appendix A, pp. 1–529, Pl. i–xxxi (xxx cancelled.—Pp. 194–267 by Prof. W. O. Atwater.

† American Fisheries—A history of the Menhaden by G. Brown Goode, with an account of the Agricultural Uses of Fish by W. O. Atwater. . . And an introduction, bringing the subject down to date. Thirty plates.—New York: Orange Judd Company. 1880. [8° pp. x, (i), iii–xii, 1–529 (1); 31 pl.—pl. 30 "cancelled."]

An edition, with a special introduction of the foregoing.

‡ The Fisheries and Fishery Industry of the United States. Prepared through the coöperation of the Commissioner of Fisheries and the Superintendent of the Tenth Census. By George Brown Goode, assistant director of the United States National Museum, and a staff of associates.—Washington: Government Printing Office. 1884 [—1887. 5 sections in 7 volumes.] "Section I, Natural History of Aquatic Animals" was mainly prepared by Doctor Goode.

concentrated on the first section, treating of the 'Natural History of Aquatic Animals,' which was discussed in over 900 pages of text and illustrated by 277 plates. This work was by far the most complete survey of the economical fishes of the country that had ever appeared and has since been the most prized; it led to another.

After the appearance of the Census volumes, Dr. Goode was urged to prepare a work for popular use. His consent to do so was followed by a volume, entitled 'American Fishes, a popular treatise upon the game and food fishes of North America,'* published by the Standard Book Company of New York. Inasmuch as none of the previous popular works on the American fishes had emanated from men of scientific eminence, it scarcely need be added that the new work had no rival in the field, so far as accurate information and details of habits were involved.

A short time previously Dr. Goode had also prepared the text to accompany a series of twenty large folio colored portraits by an eminent artist—Mr. S. A. Kilbourne—of the principal 'Game Fishes of the United States.'†

Never had investigations of the deep sea been conducted with such assiduity and skill as during the last two decades. The chief honors of the explorations were carried off by the British and American Governments. As the fishes obtained by the vessels of the United States Fish Commission were brought in, they were examined by Dr. Goode (generally in company with Dr. Bean) and duly described. At length Doctors Goode and Bean combined together data respecting all the known forms occurring in the abyssmal depths of the ocean and also those of the open sea, and published a resumé of the entire subject in two large volumes entitled 'Oceanic Ichthyology.'* This was a fitting crown to the work on which they had been engaged so long and the actual publication only preceded Dr. Goode's death by about a fortnight.

But the published volumes did not represent all the work of Dr. Goode on the abyssalian fishes. He had almost completed an elaborate memoir on the distribution of those fishes and, contrary to the conclusions of former laborers in the same field, had recognized for them a number of different faunal areas. It is to be hoped that this may yet be given to the world.

Morphological and descriptive ichthyology were not cultivated to the exclusion of what is regarded as more practical features. In connection with his official duties as an officer of the United States Fish Commission he studied the subject of pisciculture in all its details. Among his many contributions to the subject are one on 'The First decade of the United States Commission, its plan of work and accomplished results, scientific and economical' (1880), another treating of the 'Epochs in the History of Fish Culture' (1881) and two encyclopædic articles—'The Fisheries of the World' (1882), and the one entitled 'Pisciculture,' in the Encyclopædia Britannica (1885).

* American Fishes. A popular treatise upon the Game and Food Fishes of North America, with especial reference to habits and methods of capture. By G. Brown Goode. With numerous illustrations. New York; Standard Book Company. 1888. [8°, xvi+496 pp., col. frontispiece.]

† Game Fishes of the United States. By S. A. Kilbourne. Text by G. Brown Goode.—New York: Published by Charles Scribner's Sons. 1879–1881. [Folio, 46 pp., 20 plates and map.—Published in ten parts, each with 2 plates, lithographs in water color, and four page folio of text.]

* Smithsonian Institution. United States National Museum. Special Bulletin. Oceanic Ichthyology. A treatise on the Deep-Sea and Pelagic Fishes of the World, based chiefly upon the collections made by the steamers Blake, Albatross, and Fish Hawk in the Northwestern Atlantic, with an Atlas containing 417 figures, by George Brown Goode, Ph.D., LL.D., and Tarleton H. Bean, M.D., M.S. Washington: Government Printing Office. 1895. 2 vols., 4°; I., xxxv+26*, 553 pp.; II., xxiii+26* pp., 123 pl.

Although Dr. Goode's zoological publications were principally ichthyological, it was not because of narrowed sympathies or knowledge. As a naturalist he had acquaintance with several classes of the animal kingdom and especially with the vertebrates. He even published several minor contributions on herpetology, the voices of crustaceans, and other subjects.

Anthropology naturally secured a due proportion of his regards and, indeed, his catalogues truly embraced the outlines of a system of the science. As a worker in that field he has been considered recently by Dr. Mason in *The American Anthropologist*, IX., 353, 354.

The flowering plants also enlisted much of his attention and his excursions into the fields and woods were enlivened by a knowledge of the objects he met with.

Dr. Goode's bent of mind was to the historical investigation of a subject and historical matters enlisted much of his attention. Two addresses on the progress of the biological sciences in the United States, given by him as the retiring president of the Biological Society of Washington, well exemplified his diligence in the collection of data and his skill in presenting them, and it is to be hoped that they may be republished in a more available form.

These addresses entitled 'The beginnings of Natural History in America' were delivered in 1886 and 1887 and were published in the third and fourth volumes of the Proceedings of the Biological Society of Washington. The pages of the old chroniclers of American affairs, scarcely ever consulted by naturalists, had been ransacked and the items of interest culled for these choice addresses.

The addresses were subsequently supplemented by an essay on 'The Origin of the National Scientific and Educational Institutions of the United States' (1890), contributed to the American Historical Association.

Bibliography was also a favorite subject with Dr. Goode and he derived much pleasure from the inquiries which that word indicates. He completed exhaustive enumerations of the works of two of the most prominent writers on American vertebrates, and these were published by the Smithsonian Institution as Bulletins of the United States National Museum and as numbers of a series of 'Bibliographies of American Naturalists.' The first was devoted to Spencer Fullerton Baird (1883), and the fifth to Charles Girard (1891), frequently colaborers in olden times. Another (not yet published, but entirely printed) records the numerous memoirs of Philip Lutley Sclater, the distinguished ornithologist of England, who survives his biographer.

A gigantic work in the same line had been projected by him and most of the materials collected; it was no less than a complete bibliography of Ichthyology, including the names of all genera and species published as new. Whether this can be completed by another hand remains to be seen. While the work is a great desideration, very few would be willing to undertake it or even arrange the material already collected for publication. In no way may Ichthyology, at least, more feel the loss of Goode than in the loss of the complete bibliography.

The same inclination that led to historical investigation conducted him further into genealogy. As a result of some of his studies in that line, a large volume on the genealogy of the Goode family appeared in 1892 as a private publication with the title 'Virginia Cousins*.' It was printed for

* Virginia Cousins. A study of the Ancestry and Posterity of John Goode, of Whitby, a Virginia colonist of the seventeenth century, with notes upon related families, a key to Southern Genealogy, and a history of the English surname, Gode, Goad, Goode or Good, from 1148 to 1887.—Richmond, Virginia: J. W. Randolph & English. 1887. [4to, xxxvi+526 pp., 54 plates.]

the author in Washington. Its nearly 600 pages and 54 plates involved the information collected during a quarter century. Much historical and biographical information of general interest is to be found in the monograph and the most approved methods are manifest in the treatment and presentation of his theme.

The author's interest did not cease with the publication of the work; it rather increased, and he received so many new contributions and so much additional information that he felt obliged to prepare for a second edition. The new material had already been intercalated with the corrected old, and the second edition was nearly ready for the press when death interposed.

Doctor Goode was blessed with a poetical vein and loved to dip into the offerings of poets, old and new. Frequent quotations are to be found in his works and many apt ones are given at the heads of the chapters of the 'Game fishes of the United States' and the "American fishes."

His disposition was a bright and sunny one and he ingratiated himself in the affections of his friends in a marked degree. He had a hearty way of meeting intimates, and a caressing cast of the arm over the shoulder of such an one often followed sympathetic intercourse.* But in spite of his gentleness, firmness and vigor in action became manifest when occasion called for them. A tribute to those qualities from his chief who is better prepared to speak than myself will fittingly supplement this notice.

THEO. GILL.

SMITHSONIAN INSTITUTION.

IT has been suggested that I should say something about my dear personal friend and official intimate, Dr. G. Brown Goode, but since Dr. Gill, who is so much better fitted for the task than I, has consented to speak of his scientific career, I prefer to leave that side of Dr. Goode's life-work in such competent hands.

I do not want the occasion to pass, however, without saying briefly that I have never known a more perfectly true, sincere and loyal character than Dr. Goode's; or a man who with a better judgment of other men, or greater ability in moulding their purposes, to his own, used these powers to such uniformly disinterested ends, so that he could maintain the discipline of a great establishment like the National Museum, while retaining the personal affection of every subordinate. He was not only possessed of the exact scientific training which found expression in the ways which Dr. Gill has noted, and as a specialist in museum administration, but was an adept in many other branches of knowledge. His historical powers in grouping incidents and events were akin to genius. His genealogical writings showed wide and accurate research, while his literary faculty displayed itself with singular charm in some of his minor writings.

But how futile these words seem to be in describing a man, of whom perhaps the best, after all, to be said, is that he was not only trusted, but beloved by all with an affection that men rarely win from one another.

S. P. LANGLEY.

SMITHSONIAN INSTITUTION.

* Several portraits have been published. The first appeared in *Harper's Weekly* in 1887 and was a fine wood engraving and excellent likeness of him at the time—on the whole (in my opinion) the most satisfactory that has been made. Imprints of the engraving were furnished by the Harpers for the 'Virginia Cousins' and inserted opposite p. 288.

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*BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.**

ADDRESS TO THE ZOOLOGICAL SECTION BY THE PRESIDENT OF THE SECTION.

(*Concluded.*)

WE now come to the strictly biological part of our subject—to the inquiry as to

*Liverpool, 1896.

how much of the whole scheme of organic evolution has been worked out in the time during which the fossiliferous rocks were formed, and how far, therefore, the time required by the geologist is sufficient.

It is first necessary to consider Lord Kelvin's suggestion that life may have reached the earth on a meteorite. Accepting this view, it might be argued that the evolution which took place elsewhere may have been merely completed, in a comparatively brief space of time, on our earth.

We know nothing of the origin of life here or elsewhere, and our only attitude towards this or any other hypothesis on the subject is that of the anxious inquirer for some particle of evidence. But a few brief considerations will show that no escape from the demands for time can be gained in this way.

Our argument does not deal with the time required for the origin of life, or for the development of the lowest beings with which we are acquainted, from the first formed beings of which we know nothing. Both these processes may have required an immensity of time; but as we know nothing whatever about them and have as yet no prospect of acquiring any information, we are compelled to confine ourselves to as much of the process of evolution as we can infer from the structure of living and fossil forms—that is, as regards animals, to the development of the simplest into the most complex Protozoa, the evolution of the Metazoa from the Protozoa, and the branching of the former into its numerous Phyla, with all their classes, orders, families, genera and species. But we shall find that this is quite enough to necessitate a very large increase in the time estimated by the geologist.

The Protozoa, simple and complex, still exist upon the earth in countless species, together with the Metazoan Phyla. Descendants of forms which in their day constituted the beginning of that scheme of evolution which I have defined above—descendants, furthermore, of a large proportion of those forms which, age after age, constituted the shifting phases of its onward progress—still exist, and in a sufficiently unmodified condition to enable us to reconstruct, at any rate in mere outline, the history of the past. Innumerable details and many phases of supreme importance are still hidden from us, some of them, perhaps, never to be recovered. But this frank admission, and the eager and premature attempts to expound too much, to go further than the evidence permits, must not be allowed to throw an undeserved suspicion upon conclusions which are sound and well supported, upon the firm conviction of every zoologist that the general trend of evolution has been, as I have stated it, that each of the Metazoan Phyla originated, directly or indirectly, in the Protozoa.

The meteorite theory, if used to shorten the time required for evolution, would, however, require that the process of evolution went backward on a scale as vast as that on which it went forward, that certain descendants of some central type, coming to the earth on a meteorite, gradually lost their Metazoan complexity and developed backward into the Protozoa, throwing off the lower Metazoan Phyla on the way, while certain other descendants evolved all the higher Metazoan groups. Such a process would shorten the period of evolution by half, but it need hardly be said that all available evidence is entirely against it.

The only other assumption by means of which the meteorite hypothesis would serve to shorten the time is even more wild and improbable. Thus it might be supposed that the evolution which we believe to have taken place on this earth really took place

elsewhere—at any rate as regards all its main lines—and that samples of all the various phases, including the earliest and simplest, reached us by a regular meteoric service, which was established at some time after the completion of the scheme of organic evolution. Hence the evidences which we study would point to an evolution which occurred in some unknown world with an age which even Prof. Tait has no desire to limit.

If these wild assumptions be rejected, there remains the supposition that, if life was brought by a meteorite, it was life no higher than that of the simplest Protozoon—a supposition which leaves our argument intact. The alternative supposition, that one or more of the Metazoan Phyla were introduced in this way while the others were evolved from the terrestrial Protozoa, is hardly worth consideration. In the first place, some evidence of a part in a common scheme of evolution is to be found in every Phylum. In the second place, the gain would be small; the arbitrary assumption would only affect the evidence of the time required for evolution derived from the particular Phylum or Phyla of supposed meteoric origin.

The meteoric hypothesis, then, can only affect our argument by making the most improbable assumptions, for which, moreover, not a particle of evidence can be brought forward.

We are therefore free to follow the biological evidence fearlessly. It is necessary, in the first place, to expand somewhat the brief outline of the past history of the animal kingdom, which has already been given. Since the appearance of the 'Origin of Species,' the zoologist, in making his classifications has attempted, as far as possible, to set forth a genealogical arrangement. Our purpose will be served by an account of the main outlines of a recent classification, which has been framed with a due consideration for all sides of zoological research, new and old, and which has met with general approval. Prof. Lankester divides the animal kingdom into two grades, the higher of which, the Enterozoa (Metazoa), were derived from the lower, the Plastidozoa (Protozoa). Each of these grades is again divided into two sub-grades, and each of these is again divided into Phyla, corresponding more or less to the older Sub-Kingdoms. Beginning from below, the most primitive animals in existence are found in the seven Phyla of the lower Protozoan sub-grade, the Gymnomyxa. Of these unfortunately only two, the Reticularia (Foraminifera) and Radiolaria, possess a structure which renders possible their preservation in the rocks. The lowest and simplest of these Gymnomyxa represent the starting point of that scheme of organic evolution which we are considering to-day. The higher order of Protozoan life, the sub-grade Corticata, contains three Phyla, no one of which is available in the fossil state. They are, however, of great interest and importance to us as showing that the Protozoan type assumes a far higher organization on its way to evolve the more advanced grade of animal life. The first formed of these latter are contained in the two Phyla of the sub-grade Cœlentera, the Porifera or Sponges, and the Nematophora or Corals, Sea Anemones, Hydrozoa and allied groups. Both of these Phyla are plentifully represented in the fossil state. It is considered certain that the latter of these, the Nematophora, gave rise to the higher sub-grade, the Cœlomata, or animals with a cœlom, or body-cavity, surrounding the digestive tract. This latter includes all the remaining species of animal in nine Phyla, five of which are found fossil—the Echinoderma, Gephyrea, Mollusca, Appendiculata and Vertebrata.

Before proceeding further, I wish to lay emphasis on the immense evolutionary his-

tory which must have been passed through before the ancestor of one of the higher of these nine Phyla came into being. Let us consider one or two examples, since the establishment of this position is of the utmost importance for our argument. First consider the past history of the Vertebrata—of the common ancestor of our Balanoglossus, Tunicates, Amphioxus, Lampreys, Fishes, Dipnoi, Amphibia, Reptiles, Birds and Mammals. Although zoologists differ very widely in their opinions as to the affinities of this ancestral form, they all agree in maintaining that it did not arise direct from the Nematophora in the lower sub-grade of Metazoa, but that it was the product of a long history within the Cœlomate sub-grade. The question as to which of the other Cœlomate Phyla it was associated with will form the subject of one of our discussions at this meeting; and I will, therefore, say no more upon this period of its evolution, except to point out that the very question itself, 'the ancestry of Vertebrates,' only means a relatively small part of the evolutionary history of the Vertebrate ancestor within the Cœlomate group. For when we have decided the question of the other Cœlomate Phylum or Phyla to which the ancestral Vertebrate belonged, there remains, of course, the history of that Phylum or those Phyla earlier than the point at which the Vertebrate diverged, right back to the origin of the Cœlomata; while, beyond and below, the wide gulf between this and the Cœlentera had to be crossed, and then, probably after a long history as a Cœlenterate, the widest and most significant of all the morphological intervals—that between the lowest Metazoon and the highest Protozoon—was traversed. But this was by no means all. There remains the history within the higher Protozoan sub-grade, in the interval from this to the lower, and within the lower sub-grade itself, until we finally retrace our steps to the lowest and simplest forms. It is impossible to suppose that all this history of change can have been otherwise than immensely prolonged; for it will be shown below that the only evidence which is available supports the belief that the changes during these earlier phases were at least as slow as those which occurred later.

If we take the history of another of the higher Phyla, the Appendiculata, we find that the evidence points in the same direction. The common ancestor of our Rotifera, earthworms, leeches, Peripatus, centipedes, insects, Crustacea, spiders and scorpions, and forms allied to all these, is generally admitted to have been Chætopod-like, and probably arose in relation to the beginnings of certain other Cœlomate Phyla, such as the Gephyrea and perhaps Mollusca. At the origin of the Cœlomate sub-grade the common ancestor of all Cœlomate Phyla is reached, and its evolution has been already traced in the case of the Vertebrata.

What is likely to be the relation between the time required for the evolution of the ancestor of a Cœlomate Phylum and that required for the evolution, which subsequently occurred, within the Phylum itself? The answer to this question depends mainly upon the rate of evolution in the lower parts of the animal kingdom as compared with that in the higher. Contrary, perhaps, to anticipation, we find that all evidences of rapid evolution are confined to the most advanced of the smaller groups within the highest Phyla, and especially to the higher Classes of Vertebrata. Such evidence as we have strongly indicates the most remarkable persistence of the lower animal types. Thus in the Class Imperforata of the Reticularia (Foraminifera) one of our existing genera (*Saccamina*) occurs in the Carboniferous strata, another (*Trochammina*) in the Permian, while a single new genus (*Receptaculites*) occurs in the Silurian and Devonian. The evidence

from the Class Perforata is much stronger, the existing genera *Nodosaria*, *Dentalina*, *Textularia*, *Grammostomum*, *Valvulina* and *Nummulina* all occurring in the Carboniferous, together with the new genera *Archædiscus* (?) and *Fusulina*.

I omit reference to the much-disputed Eozoon from the Laurentian rocks far below the horizon, which, for the purpose of this address, I am considering as the lowest fossiliferous stratum. We are looking forward to the new light which will be thrown upon this form in the communication of its veteran defender, Sir William Dawson, whom we are all glad to welcome.

Passing the Radiolaria, with delicate skeletons less suited for fossilization, and largely pelagic and, therefore, less likely to reach the strata laid down along the fringes of the continental areas, the next Phylum which is found in a fossil state is that of the Porifera, including the sponges, and divided into two classes, the Calcispongiæ and Silicospongiæ. Although the fossilization of sponges is in many cases very incomplete, distinctly recognizable traces can be made out in a large number of strata. From these we know that representatives of all the groups of both classes (except the Halisarcidæ, which have no hard parts) occurred in the Silurian, Devonian and Carboniferous systems. The whole Phylum is an example of long persistence with extremely little change. And the same is true of the Nematophora; new groups, indeed, come in, sometimes extremely rich in species, such as the Palæozoic Rugose corals and Graptolites; but they existed side by side with representatives of existing groups, and they are not in themselves primitive or ancestral. A study of the immensely numerous fossil corals reveals no advance in organization, while researches into the structure of existing Alcyonaria and Hydrocorallina have led to the interpretation of certain Palæozoic forms which were previously obscure, and the conclusion that they find their place close beside the living species.

All available evidence points to the extreme slowness of progressive evolutionary changes in the Cœlenterate Phyla, although the Protozoa, if we may judge by the Reticularia (Foraminifera), are even more conservative.

When we consider, later on, the five Cœlomate Phyla which occur fossil, we shall find that the progressive changes were slower and, indeed, hardly appreciable in the two lower and less complex Phyla, viz: the Echinoderma and Gephyrea, as compared with the Mollusca, Appendiculata and Vertebrata.

Within these latter Phyla we have evidence for the evolution of higher groups presenting a more or less marked advance in organization. And not only is the rate of development more rapid in the highest Phyla of the animal kingdom, but it appears to be most rapid when dealing with the highest animal tissue, the central nervous system. The chief, and doubtless the most significant, difference between the early Tertiary mammals and those which succeeded them, between the Secondary and Tertiary reptiles, between man and the mammals most nearly allied to him, is a difference in the size of the brain. In all these cases an enormous increase in this, the dominant tissue of the body, has taken place in a time which, geologically speaking, is very brief.

When treating, later on, of the evolution which has taken place within the Phyla, further details upon this subject will be given, although in this, as in other cases, the time at our disposal demands that the exposition of evidence must largely yield to an exposition of the conclusions which follow from its study. And undoubtedly a study of all the available evidence points to the conclusion that in the lower

grade, sub-grades and Phyla of the animal kingdom evolution has been extremely slow as compared with that in the higher. We do not know the reason. It may be that this remarkable persistence through the stratified series of deposits is due to an innate fixity of constitution which has rigidly limited the power of variation; or, more probably, perhaps, that the lower members of the animal kingdom were, as they are now, more closely confined to particular environments, with particular sets of conditions, with which they had to cope, and, this being successfully accomplished, natural selection has done little more than keep up a standard of organization which was sufficient for their needs; while the higher and more aggressive forms ranging over many environments, and always prone to encounter new sets of conditions, were compelled to undergo responsive changes or to succumb. But whatever be the cause, the fact remains, and is of great importance for our argument. When the ancestor of one of the higher Phyla was associated with the lower Phyla of the Cœlomate sub-grade, when further back it passed through a Cœlenterate, a higher Protozoan, and finally a lower Protozoan phase, we are led to believe that its evolution was probably very slow as compared with the rate which it subsequently attained. But this conclusion is of the utmost importance; for the history contained in the stratified rocks nowhere reveals to us the origin of a Phylum. And this is not mere negative evidence, but positive evidence of the most unmistakable character. All the five Cœlomate Phyla which occur fossil appear low down in the Palæozoic rocks, in the Silurian or Cambrian strata, and they are represented by forms which are very far from being primitive, or, if primitive, are persistent types. such as Chiton, which are now living, Thus Vertebrata are represented by fishes, both sharks and ganoids; the Appendiculata by cockroaches, scorpions, Limulids, Trilobites and many Crustacea; the Mollusca by Nautilus and numerous allied genera, by Dentalium, Chiton, Pteropods, and many Gastropods and Lamellibranchs; the Gephyrea by very numerous Brachiopods and many Polyzoa; the Echinoderma by Crinoids, Cystoids, Blastoids, Asteroids, Ophiuroids and Echinoids. It is just conceivable, although, as I believe, most improbable, that the Vertebrate Phylum originated at the time when the earliest known fossiliferous rocks were laid down. It must be remembered, however, that an enormous morphological interval separates the fishes which appear in the Silurian strata from the lower branches, grades and classes of the Phylum in which Balanoglossus, the Ascidians, Amphioxus and the Lampreys are placed. The earliest Vertebrates to appear are, in fact, very advanced members of the Phylum, and, from the point of view of anatomy, much nearer to man than to Amphioxus. If, however, we grant the improbable contention that so highly organized an animal as a shark could be evolved from the ancestral Vertebrate in the period which intervened between the earliest Cambrian strata and the Upper Silurian, it is quite impossible to urge the same with regard to the other Phyla. It has been shown above that when these appear in the Cambrian and Silurian they are flourishing in full force, while their numerous specialized forms are a positive proof of a long antecedent history within the limits of the Phylum.

If, however, we assume for the moment that the Phyla began in the Cambrian, the geologist's estimate must still be increased considerably, and perhaps doubled, in order to account for the evolution of the higher Phyla from forms as low as many which are now known upon the earth; unless, indeed, it is supposed, against the whole weight of

all such evidence as is available, that the evolutionary history in these early times was comparatively rapid.

To recapitulate, if we represent the history of animal evolution by the form of a tree, we find that the following growth took place in some age antecedent to the earliest fossil records, before the establishment of the higher Phyla of the animal kingdom. The main trunk representing the lower Protozoa divided, originating the higher Protozoa; the latter portion again divided, probably in a threefold manner, originating the two lowest Metazoan Phyla, constituting the Cœlentera. The branch representing the higher of these Phyla, the Nematophora, divided, originating the lower Cœlomate Phyla, which again branched and originated the higher Phyla. And, as has been shown above, the relatively ancestral line, at every stage of this complex history, after originating some higher line, itself continued down to the present day, throughout the whole series of fossiliferous rocks, with but little change in its general characters, and practically nothing in the way of progressive evolution. Evidences of marked advance are to be found alone in the most advanced groups of the latest highest products—the Phyla formed by the last of these divisions.

It may be asked how is it possible for the zoologist to feel so confident as to the past history of the various animal groups. I have already explained that he does not feel this confidence as regards the details of the history, but as to its general lines. The evidence which leads to this conviction is based upon the fact that animal structure and mode of development can be, and have been, handed down from generation to generation from a period far more remote than that which is represented by the earliest fossils; that fundamental facts in structure and development may remain changeless amid endless changes of a more general character; that especially favorable conditions have preserved ancestral forms comparatively unchanged. Working upon this material, comparative anatomy and embryology can reconstruct for us the general aspects of a history which took place long before the Cambrian rocks were deposited. This line of reasoning may appear very speculative and unsound, and it may easily become so when pressed too far. But applied with due caution and reserve, it may be trusted to supply us with an immense amount of valuable information which cannot be obtained in any other way. Furthermore, it is capable of standing the very true and searching test supplied by the verification of predictions made on its authority. Many facts taken together lead the zoologist to believe that A was descended from C through B; but if this be true, B should possess certain characters which are not known to belong to it. Under the inspiration of hypothesis a more searching investigation is made, and the characters are found. Again, that relatively small amount of the whole scheme of animal evolution which is contained in the fossiliferous rocks has furnished abundant confirmation of the validity of the zoologist's method. The comparative anatomy of the higher Vertebrate Classes leads the zoologist to believe that the toothless beak and the fused caudal vertebræ of a bird were not ancestral characters, but were at some time derived from a condition more conformable to the general plan of vertebrate construction, and especially to that of reptiles. Numerous secondary fossils prove to us that the birds of that time possessed teeth and separate caudal vertebræ, culminating in the long lizard-like tail of Archæopteryx.

Prediction and confirmation of this kind, both zoological and paleontological, have been going on ever since the historic point of view was adopted by the naturalist as the outcome of Darwin's teaching, and the zoologist may safely claim that his method,

confirmed by paleontology so far as evidence is available, may be extended beyond the period in which such evidence is to be found.

And now our last endeavor must be to obtain some conception of the amount of evolution which has taken place within the higher Phyla of the animal kingdom during the period in which the fossiliferous rocks were deposited. The evidence must necessarily be considered very briefly, and we shall be compelled to omit the Vertebrata altogether.

The Phylum Appendiculata is divided by Lankester into three branches, the first containing the Rotifera, the second the Chætopoda, the third the Arthropoda. Of these the second is the oldest and gave rise to the other two, or at any rate to the Arthropoda, with which we are alone concerned, inasmuch as the fossil records of the others are insufficient. The Arthropoda contain seven classes, divided into two grades, according to the presence or absence of antennæ—the Ceratophora, containing the Peripatoidea, the Myriapoda and the Hexapoda (or insects); the Acerata, containing the Crustacea, Arachnida, and two other classes (the Pantopoda and Tardigrada) which we need not consider. The first class of the antenna-bearing group contains the single genus Peripatus—one of the most interesting and ancestral of animals, as proved by its structure and development and by its immense geographical range. Ever since the researches of Moseley and Balfour, extended more recently by those of Sedgwick, it has been recognized as one of the most beautiful of the connecting links to be found amongst animals, uniting the antenna-bearing Arthropods, of which it is the oldest member, with the Chætopods. Peripatus is a magnificent example of the far-reaching conclusions of zoology, and of its superiority to paleontology as a guide in unravelling the tangled history of animal evolution. Peripatus is alive to-day, and can be studied in all the details of its structure and development; it is infinitely more ancestral, and tells of a far more remote past than any fossil Arthropod, although such fossils are well known in all the older of the Palæozoic rocks. And yet Peripatus is not known as a fossil. Peripatus has come down, with but little change, from a time, on a moderate estimate, at least twice as remote as the earliest known Cambrian fossil. The agencies which, it is believed, have crushed and heated the Archæan rocks so as to obliterate the traces of life which they contained were powerless to efface this ancient type, for, although the passing generations may have escaped record, the likeness of each was stamped on that which succeeded it, and has continued down to the present day. It is, of course, a perfectly trite and obvious conclusion, but not the less one to be wondered at, that the force of heredity should thus far outlast the ebb and flow of terrestrial change throughout the vast period over which the geologist is our guide.

If, however, the older Palæozoic rocks tell us nothing of the origin of the antenna-bearing Arthropods, what do they tell us of the history of the Myriapod and Hexapod Classes?

The Myriapods are well represented in Palæozoic strata, two species being found in the Devonian and no less than thirty-two in the Carboniferous. Although placed in an Order (Archipolypoda) separate from those of living Myriapods, these species are by no means primitive and do not supply any information as to the steps by which the Class arose. The imperfection of the record is well seen in the traces of this Class; for between the Carboniferous rocks and the Oligocene there are no remains of undoubted Myriapods.

We now come to the consideration of insects, of which an adequate discussion

would occupy a great deal too much of your time. An immense number of species are found in the Palæozoic rocks, and these are considered by Scudder, the great authority on fossil insects, to form an Order, the Palæodictyoptera, distinct from any of the existing Orders. The latter, he believes, were evolved from the former in Mesozoic times. These views do not appear to derive support from the wonderful discoveries of M. Brongniart* in the Upper Carboniferous of Commentry in the Department of Allier, in central France. Concerning this marvellous assemblage of species, arranged by their discoverer in 46 genera and 101 species, Scudder truly says:

"Our knowledge of Palæozoic insects will have been increased three or fourfold at a single stroke * * * No former contribution in this field can in any way compare with it, nor even all former contributions taken together." †

When we remember that the group of fossil insects, of which so much can be affirmed by so great an authority as Scudder, lived at one time and in a single locality, we cannot escape the conclusion that the insect fauna of the habitable earth during the whole Palæozic period was of immense importance and variety. Our knowledge of this single group of species is largely due to the accident that coal-mining in Commentry is carried on in the open air.

Now, these abundant remains of insects, so far from upholding the view that the existing orders had not been developed in Palæozic times, are all arranged by Brongniart in four out of the nine Orders into which insects are usually divided, viz: the Orthoptera, Neuroptera, Thysanoptera and Homoptera. The importance of the discovery is well seen in the Neuroptera, the whole known Palæozoic fauna of this order being divided into 45 genera and 99 species, of which 33 and 72 respectively have been found at Commentry.

Although the Carboniferous insects of Commentry are placed in new families, some of them come wonderfully near those into which existing insects are classified, and obviously form the precursors of these. This is true of the Blattidæ, Phasmidæ, Acridiidæ and Locustidæ among the Orthoptera, the Perlidæ among the Neuroptera, and the Fulgoridæ among the Homoptera. The differences which separate these existing families from their Carboniferous ancestors are most interesting and instructive. Thus the Carboniferous cockroaches possessed ovipositors and probably laid their eggs one at a time, while ours are either viviparous or lay their eggs in a capsule. The Protophasmidæ resemble living species in the form of the head, antennæ, legs and body; but while our species are either wingless or, with exception of the female Phyllidæ, have the anterior pair reduced to tegmina, useless for flight, those of Palæozoic times possessed four well-developed wings. The forms representing locusts and grasshoppers (Palæacridiidæ) possessed long slender antennæ like the green grasshoppers (Locustidæ), from which the Acridiidæ are now distinguished by their short antennæ. The divergence and specialization which is thus shown is amazingly small in amount. In the vast period between the Upper Carboniferous rocks and the present day the cockroaches have gained a rather different wing venation, and have succeeded in laying their eggs in a manner rather more specialized than that of insects in general; the stick insects and leaf insects have lost or reduced their wings, the grasshoppers have shortened their antennæ. These, however,

*Charles Brongniart.—'Recherches pour servir á l'Histoire des Insectes fossiles des temps primaires, précédées d'une Etude sur la nervation des ailes des Insectes.' 1894.

†S. H. Scudder, *Am. Journ. Sci.* Vol. XLVII., February, 1894. Art. viii.

are the insects which most closely resemble the existing species; let us turn to the forms which exhibit the greatest differences. Many species have retained in the adult state characters which are now confined to the larval stage of existence, such as the presence of tracheal gills on the sides of the abdomen. In some the two membranes of the wing were not firmly fixed together, so that the blood could circulate freely between them. On the other hand, they are not very firmly fixed together in existing insects. Another important point was the condition of the three thoracic segments, which were quite distinct and separate, instead of being fused as they are now in the imago stage. The external difference probably also extended to the nervous system, so that the thoracic ganglia were separate instead of concentrated. The most interesting distinction, however, was the possession by many species of a pair of prothoracic appendages much resembling miniature wings, and which especially suggest the appearance assumed by the anterior pair (tegmina) in existing Phasmidæ. There is some evidence in favor of the view that they were articulated, and they exhibit what appears to be a trace of venation. Brongniart concludes that, in still earlier strata, insects with six wings will be discovered, or rather insects with six of the tracheal gills sufficiently developed to serve as parachutes. Of these, the two posterior pair developed into wings as we know them, while the anterior pair degenerated, some of the Carboniferious insects presenting us with a stage in which degeneration had taken place but was not complete.

One very important character was, as I have already pointed out, the enormous size reached by insects in this distant period. This was true of the whole known fauna as compared with existing species, but it was especially the case with the Protodonata, some of these giant dragon-flies measuring over two feet in the expanse of the wings.

As regards the habits of life and metamorphoses, Brongniart concludes that some species of Protoephemeridæ, Protopelidæ, etc., obtained their food in an aquatic larval stage and did not require it when mature. He concludes that the Protodonata fed on other animals, like our dragon-flies; that the Palæacridiidæ were herbivorous like our locusts and grasshoppers, the Protolocustidæ herbivorous and animal feeders like our green grasshoppers, the Palæoblattidæ omnivorous like our cockroaches. The Homoptera, too, had elongated sucking mouth-parts like the existing species. It is known that in Carboniferous times there was a lake with rivers entering it, at Commentry. From their great resemblance to living forms of known habits, it is probable that the majority of these insects lived near the water and their larvæ in it.

When we look at this most important piece of research as a whole, we cannot fail to be struck with the small advance in insect structure which has taken place since Carboniferous times. All the great questions of metamorphosis, and of the structures peculiar to insects, appear to have been very much in the position in which they are to-day. It is, indeed, probable enough that the Orders which zoologists have always recognized as comparatively modern and specialized, such as the Lepidoptera, Coleoptera and Hymenoptera, had not come into existence. But as regards the emergence of the Class from a single primitive group, as regards its approximation towards the Myriapods, which lived at the same time, and of both towards their ancestor Peripatus, we learn absolutely nothing. All we can say is that there is evidence for the evolution of the most modern and specialized members of the Class, and some slight evolution in the rest. Such evolution is of importance as giving

us some vague conception of the rate at which the process travels in this division of the Arthropoda. If we look upon development as a series of paths which, by successively uniting, at length meet in a common point, then some conception of the position of that distant center may be gained by measuring the angle of divergence and finding the number of unions which occur in a given length. In this case the amount of approximation and union shown in the interval between the Carboniferous period and the present day is relatively so small that it would require to be multiplied many times before we could expect the lines to meet in the common point, the ancestor of insects, to say nothing of the far more distant past in which the Tracheate Arthropods met in an ancestor presenting many resemblances to Peripatus. But it must not be forgotten that all this vast undefined period is required for the history of one of the two grades of one of the three branches of the whole Phylum.

Turning now to the brief consideration of the second grade of Arthropods, distinguished from the first grade by the absence of antennæ, the Trilobites are probably the nearest approach to an ancestral form met with in the fossil state. Now that the possession of true antennæ is certain, it is reasonable to suppose that the Trilobites represent an early class of the Aceratous branch which had not yet become Aceratous. They are thus of the deepest interest in helping us to understand the origin of the antennaless branch, not by the ancestral absence, but by the loss of true antennæ which formerly existed in the group. But the Trilobites did not themselves originate the other classes, at any rate during Palæozoic times. They represent a large and dominant class, presenting more of the characters of the common ancestor than the other classes; but the latter had diverged and had become distinct long before the earliest fossiliferous rocks; for we find well-marked representatives of the Crustacea in Cambrian, and of the Arachnida in Silurian strata. The Trilobites, moreover, appear in the Cambrian with many distinct and very different forms, contained in upwards of forty genera, so that we are clearly very far from the origin of the group.

Of the lower group of Crustacea, the Entomostraca, the Cirripedes are represented by two genera in the Silurian, the Ostracodes by four genera in the Cambrian and over twenty in the Silurian; of these latter two genera, Cythere and Bairdia, continue right through the fossiliferous series and exist at the present day. Remains of Phyllopods are more scanty, but can be traced in the Devonian and Carboniferous rocks. The early appearance of the Cirripedes is of special interest, inasmuch as the fixed condition of these forms in the mature state is certainly not primitive, and yet, nevertheless, appears in the earliest representatives.

The higher group, Malacostraca, are represented by many genera of Phyllocarida in the Silurian and Devonian, and two in the Cambrian. These also afford a good example of the imperfection of the record, inasmuch as no traces of the group are to be found between the Carboniferous and our existing fauna in which it is represented by the genus Nebalia. The Phyllocarida are recognized as the ancestors of the higher Malcostraca, and yet these latter already existed—in small numbers, it is true—side by side with the Phyllocarida in the Devonian. The evolution of the one into the other must have been much earlier. Here, as in the Arthropoda, we have evidence of progressive evolution among the highest groups of the class, as we see in the comparatively late development of the Brachyura as compared with the Macrura. We find no trace of the origin of the class, or of the larger groups into which it is di-

vided, or, indeed, of the older among the small groupings into families and genera.*

Of the Arachnida, although some of the most wonderful examples of persistent types are to be found in this class, but little can be said. Merely to state the bare fact that three kinds of scorpions are found in the Silurian, two Pedipalpi, eight scorpions, and two spiders in the Carboniferous, is sufficient to show that the period computed by geologists must be immensely extended to account for the development of this class alone, inasmuch as it existed in a highly specialized condition almost at the beginning of the fossiliferous series; while, as regards so extraordinarily complex an animal as a scorpion, nothing apparent in the way of progressive development has happened since. Prof. Lankester has, however, pointed out to me that the Silurian scorpions possessed heavier limbs than those of existing species, and this is a point in favor of their having been aquatic, like their near relation, Limulus. If so, it is probable that they possessed external gills, not yet inverted to form the lung-book. The Merostomata are, of course, a Palæozoic group, and reach their highest known development at their first appearance in the Silurian; since then they have done nothing but disappear gradually, leaving the single genus Limulus, unmodified since its first appearance in the Trias, to represent them. It is impossible to find clearer evidence of the decline rather than the rise of a group. No progressive development, but a gradual or rapid extinction, and consequent reduction in the number of genera and species, is a summary of the record of the fossiliferous rocks as regards this group and many others, such as the Trilobites, the Brachiopods and the Nautilidæ. All these groups begin with many forms in the oldest fossiliferous rocks, and three of them have left genera practically unchanged from their first appearance to the present day. What must have been the time required to carry through the vast amount of structural change implied in the origin of these persistent types and the groups to which they belong—a period so extended that the interval between the oldest Palæozoic rocks and the present day supplies no measureable unit?

But I am digressing from the Appendiculate Phylum. We have seen that the fossil record is unusually complete as regards two classes in each grade of the Arthropod branch, but that these classes were well developed and flourishing in Palæozoic times. The only evidence of progressive evolution is in the development of the highest orders and families of the classes. Of the origin of the classes nothing is told, and we can hardly escape the conclusion that for the development of the Arthropod branches from a common Chætopod-like ancestor, and for the further development of the classes of each branch, a period many times the length of the fossiliferous series is required, judging from the insignificant amount of development which has taken place during the formation of this series.

It is impossible to consider the other Cœlomate Phyla as I have done the Appendiculata. I can only briefly state the conclusions to which we are led.

As regards the Molluscan Phylum, the evidence is perhaps even stronger than in the Appendiculata. Representatives of the whole of the classes are, it is believed, found in the Cambrian or Lower Silurian. The Pteropods are generally admitted to be a recent modification of the Gastropods, and yet, if the fossils described in the genera Conularia, Hyolithes, Pterotheca, etc., are true Pteropods, as they are supposed to be, they occur in the Cambrian and Silurian strata, while the group of Gastropods

* For an account of the evolution of the Crustacea see the Presidential Addresses to the Geological Society of London in 1895 and 1896 by Dr. Henry Woodward.

from which they almost certainly arose, the Bullidæ, are not known before the Trias. Furthermore, the forms which are clearly the oldest of the Pteropods—Limacina and Spirialis—are not known before the beginning of the Tertiary Period. Either there is a mistake in the identification of the Palæozoic fossils as Pteropods, or the record is even more incomplete than usual, and the most specialized of all Molluscan groups had been formed before the date of the earliest fossiliferous rocks. If this should hereafter be disproved, there can be no doubt about the early appearance of the Molluscan classes, and that it is the irony of an incomplete record which places the Cephalopods and Gastropods in the Cambrian and the far more ancestral Chiton no lower than the Silurian. Throughout the fossiliferous series the older families of Gastropods and Lamellibranchs are followed by numerous other families, which were doubtless derived from them; new and higher groups of Cephalopods were developed, and, with the older groups, either persisted until the present time or became extinct. But in all this splitting up of the classes into groups of not widely different morphological value, there is very little progressive modification, and, taking such changes in such a period as our unit for the determination of the time which was necessary for the origin of the classes from a form like Chiton, we are led to the same conclusion as that which followed from the consideration of the Appendiculata, viz: that the fossiliferous series would have to be multiplied several times in order to provide it.

Of the Phylum Gephyrea, I will only mention the Brachiopods, which are found in immense profusion in the early Palæozoic rocks and which have occupied the subsequent time in becoming less dominant and important. So far from helping us to clear up the mystery which surrounds the origin of the class, the earliest forms are quite as specialized as those living now, and, some of them (Lingula, Discina) even generically identical. The demand for time to originate the group is quite as grasping as that of the others we have been considering.

All the classes of Echinoderma, except the Holothurians, which do not possess a structure favorable for fossilization, are found early in the Palæozoic rocks, and many of them in the Cambrian. Although these early forms are very different from those which succeeded them in the later geological periods, they do not possess a structure which can be recognized as in any way primitive or ancestral. The Echinoderma are the most distinct and separate of all the Cœlomate Phyla, and they were apparently equally distinct and separate at the beginning of the fossiliferous series.

In concluding this imperfect attempt to deal with a very vast subject in a very short time, I will remind you that we were led to conclude that the evolution of the ancestor of each of the higher animal Phyla, probably occupied a very long period, perhaps as long as that required for the evolution which subsequently occurred within the Phylum. But the consideration of the higher Phyla which occur fossil, except the Vertebrata, leads to the irresistible conclusion that the whole period in which the fossiliferous rocks were laid down must be multiplied several times for this later history alone. The period thus obtained requires to be again increased, and perhaps doubled, for the earlier history.

In the preparation of the latter part of this address I have largely consulted Zittel's great work. I wish also to express my thanks to my friend, Prof. Lankester, whom I have consulted on many of the details, as well as the general plan which has been adopted.

E. B. Poulton.

Oxford.

PLANS FOR THE PROPOSED ZOOLOGICAL PARK IN NEW YORK.

LAST spring the plans of the New York Zoological Society reached a point where it became necessary to take up the many questions involved in the design and construction of buildings and other enclosures for animals, and also their arrangement in the proposed Zoological Park. The Executive Committee realized the necessity of a thorough examination and study of the best zoological gardens of Europe.

Accordingly, Mr. William T. Hornaday, the Director, was instructed to visit all the large gardens of Europe, examine them carefully, and bring back photographs and designs of their most valuable and interesting features. He left New York in June, and visited the zoological gardens of the following cities, in the order named: London, Antwerp, Rotterdam, The Hague, Amsterdam, Hanover, Hamburg, Berlin, Dresden, Leipsic, Frankfort, Cologne and Paris. Altogether fifteen gardens were inspected, and their best features were photographed, sketched and studied throughout. Without an exception, the Directors, Superintendents and Inspectors of the gardens visited were very cordial. Every fact asked for was cheerfully furnished, without the slightest hesitation or reservation. Not only were good features pointed out as being worthy of special attention, but some officers very kindly indicated the mistakes that had been made in their gardens in the early days when everything had to be determined by experiment, thus showing what to avoid.

In London, Dr. P. L. Sclater, the executive head of the London Zoological Society, gave all the information and facilities for photographing that were desired in the Society's gardens, and Mr. Clarence Bartlett, Assistant Superintendent, explained the entire working machinery of this truly magnificent zoological institution.

At Antwerp the visitor is fairly amazed at the perfection of all the larger buildings for animals and the extreme beauty and attractiveness of nearly every feature of that scientific establishment. Director L'hoest and his Assistant, M. J. De Winter, were untiring in their willingness to afford all the information desired, and to show everything not open to general view. Only two and one-half hours distant is found the beautiful garden at Rotterdam, known to but few Americans, where Dr. Von Bemmelin pointed out with pardonable pride the newest lion house, in Europe, and the first great flying cage ever constructed for the larger wading birds. An equally short distance farther on, at Amsterdam, is found a very rich colleclection, installed amid charming surroundings, in which the health and 'condition' of every bird and quadruped seems absolutely perfect. In the absence of Director Kerbert, Inspector Castens devoted hours of time to answering the question, "How do you keep everything in such fine condition?"

At Hanover, Dr. Ernest Schäff fully explained the plan of foundation and management of his zoological *forest*, and supplied a plan of the new and admirably constructed Antelope House. At Berlin was found another royal establishment, with the larger mammalia housed in ornate and costly buildings. The garden occupies part of imperial grounds and it is one of which the citizens of Berlin may well be proud. Dr. Ludwig Heck, its director, became much interested in the New York plan, and his cooperation was heartily extended. At Hamburg another very fine garden was inspected, in which all the shade is the result of artificial planting. It thus affords a fine opportunity to observe what can be accomplished if sufficient time is allowed. The shade trees are now very beautiful, and at once impress the expert visitor as being remarkably well distributed to serve their purpose of shading

both the out-door animals and the walks. Two days were spent with Herr Carl Hagenbeck, who has at Hamburg a *Thier-park* of his own, quite as large as the Central Park Menagerie of New York. Probably no man living has given more study to the problems of zoological garden construction and the care of animals in captivity, and Mr. Hornaday found him not only willing but eager to explain the mistakes to avoid, as well as the latest developments in the care of animals.

The director of the very interesting garden at Cologne, Dr. Wunderlich, was quite as ready with helpful information as his colleagues of other cities, and some of the features of his establishment were found to possess exceptional interest. The Frankfort garden contains much that is new and admirable. Prof. Milne Edwards, Director of the Paris *Jardin des Plantes*, also extended every facility for study and examination of this the oldest garden of Europe. Regarding the status of a garden which, like this, is free to the entire public, the experiences and observations of Prof. Milne Edwards were both interesting and valuable. He expressed the opinion that no zoological garden should be kept open every day in the week, principally because it is not best for the collections.

The store of photographs, sketches, notes and plans collected during this tour are now being utilized in the preliminary plans for the New York Park. It is proposed to determine the location and general design of every building and enclosure before the project is finally submitted to the city authorities in January, 1897. The site selected by the Society is the southern portion of Bronx Park, about a quarter of a mile south of the Botanical Garden. According to the Charter granted to the Society by the New York Legislature in 1895, the approval of this selection rests with the Mayor and Commissioners of the Sinking Fund.

CURRENT NOTES ON PHYSIOGRAPHY.

GLACIAL SAND PLAINS ABOUT NARRAGANSETT BAY.

The geographical significance of glacial action is well exhibited in an account of the 'Retreat of the ice sheet in the Narragansett bay region,' by J. B. Woodworth (*Amer. Geol.*, XVIII., 1896, 150–168). Sand Plains, stretching east and west, repeatedly succeed one another on a north-south line. Each plain was formed rapidly by streams flowing out from the margin of the slowly retreating ice sheet into standing water; whether the standing water was an arm of the sea, then about fifty feet higher than now, or a local water body, is not determined. Each plain has the gently sloping surface, the lobate front and the peculiarly stratified structure of a delta; but at the head the plain falls off northward in a steep slope, associated with kames, and descending to a lowland area that is often boulder-strewn and marked by gravel mounds or occupied by swampy basins drained by sluggish streams; here the ice sheet stood while the plain was forming. This lowland is compared to the 'fosse,' a marked feature on Nantucket, between the head of the great sand plain on the south and the moranic till mounds on the north. The same might be said of the similar fosse on Martha's Vineyard.

A small but well defined boulder moraine in southwest Rhode Island is described by Woodworth and Marbut (Chicago Journ. Geol., IV., 1896, 691–703).

TOPOGRAPHIC TERMS OF SPANISH AMERICA.

The richness of some languages and the poverty of others in terms descriptive of topographic form has often been remarked. The New Englander never invented a generic name for the numerous drumlins that he early selected for clearing; they were to him simply 'hills.' The Spanish race is more appreciative and a num-

ber of Spanish-American topographic terms are now brought together by R. T. Hill, who illustrates their value by using them in a few sample descriptions (*Nat. Geogr. Mag.*, VII., 1896, 291–302): "An appropriate generic term should be provided for every possible form of the earth's surface, so that when referred to it may be as readily recognized as are the parts of a building in an architectural description."

It is to be noted that the terms quoted by Hill are purely empirical, connoting in their original usage no explanation, although Hill now gives them certain physiographic limitations. They are thus like *delta*, *atoll* and *drumlin*, and are quite unlike *anarregmatic* and *heteroptygmatic*, invented by Löwl; *anaclinal* and *cataclinal*, proposed by Powell, and *beheadland* and *inface*, of other authors. The precise definition of the Spanish-American terms by an expert familiar with the ground is a valuable contribution to exact geography; but it is questionable whether a wholesale introduction of foreign words from a single language (if this be contemplated) is desirable in reports on our western country, where such terms may have a certain currency. Instead of adopting Spanish-American words, let us imitate their methods and evolve our own words; or let us be more cosmopolitan and take appropriate words from many languages. For the Spanish *teta*, the Scotch have *pap;* for *huerfano*, there is the French *témoin*, if our own *outlier* does not suffice; for *caleta*, we could import *beck* or *gill*, from north England; for *plaza*, there is the Hindu *khadar*, or the Scotch *strath*, and so with many others. The chief advantage of foreign words is that they are to us meaningless, except in their special use. This advantage is indeed shared by terms like *symptygmatic*, *diaclinal* and *obsequent;* yet such terms are for some reason hardly used by others than their inventors. After all, terms will grow rapidly enough if we have term-users, studious observers of the face of the earth. Without these the richest terminology is of no avail.

MATURE AND IMMATURE GEOGRAPHY.

THE current style of geographical description is essentially immature, in that it differs from the geography of school years in quantity rather than in quality. There is no reproach in designating the geography appropriate to school children as 'childish,' but it is a reproach to the science of geography to find so great a quantity of material not beyond childish quality in geographical journals intended for mature readers. The general phrasing is, of course, more mature than that adapted to school use, but the geographical terms are hardly increased beyond the small stock gathered from elementary text-books, and the relation of earth and man often has to be inferred by the reader from the diverse and disconnected facts reported by the writer. Mountains and valleys, plains and plateaus, rivers and lakes; high and low, broad and narrow, imposing and tame, fertile and barren—these are fair samples of the nouns and adjectives used by explorers in describing the varied features of the land. Manifest relations, such as the avoidance of rugged mountains and the occupation of fertile valleys, the location of trails over passes, the migration of wandering tribes with the seasons, are commonly enough stated explicitly, as they might be in an elementary school book; but the more advanced discussion of the relation of earth and man is seldom consciously undertaken.

It is plain that the advance of geography to a mature stage, appropriate to the age of adult students, explorers and readers, requires serious preparatory discipline in various directions: First, in the systematic, scientific study of land and water forms, so that new examples of known kinds may be easily recognized and briefly named, and

so that examples of novel, undescribed kinds may be attentively studied when discovered. Second, in the equally thorough study of the manifold types of weather and climate, so that they may be similarly treated. Third, in the equally thorough study of the various relations between earth and man—anthropogeography; or, if desired, between earth and all forms of life —biogeography; for then only can the human or organic element be stated in its geographical relations, and not simply in its anthropological or biological relations. A person who is untrained in these directions may, of course, follow known paths as a traveller, or break new paths as an explorer; but it is questionable whether he should be called a geographer.

GLACIAL ACTION AND SHIFTING DIVIDES IN THE SCHWARZWALD.

G. Steinmann has recently discussed the glacial phenomena of the Schwarzwald (Die Spuren der letzen Eiszeit im hohen Schwarzwalde. Freiburg Univ. Festprogr., 1896). From ice fields above 700 m., many valley glaciers descended to 400 m. Glaciated surfaces smoothed valleys, cirques, rock basins, terminal moraines and valley gravels are all described in evidence of ice action. The author is led to ascribe the diversion of former headwaters from the Wutach (Danube system) to the Höllenthal (Rhine system) by ice-barring. Map and profiles give clear illustration of the inferred process, which Steinmann naturally prefers to the cataclysmic explanation suggested by Fromherz half a century ago. But the width (about 1 k.) of the Höllenthal across the old divide seems too great to have been gained in post-glacial time. Furthermore, no consideration is given to the normal process of shifting divides by the more rapid gnawing at the steeper headwater (Höllenthal). This slow process is undoubtedly responsible for the repeated examples of shifted divides between Rhine and Danube headwaters farther northeast in the Swabian Alp, where the 'cuesta,' as Hill might call it, or the 'Stufenlandschaft,' as Penck would say, becomes dominant. It therefore seems probable that normal shifting may find some application in the Schwarzwald also.

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CURRENT NOTES ON ANTHROPOLOGY.

THE INDIAN QUESTION.

In practical sociology no question has so long worried the American philanthropists as 'What to do with the Indians.' Even the archæologists—who are popularly supposed to agree with General Crook, that the only good Indian is a dead Indian—have taken it up, and in the last number of the Proceedings of the American Antiquarian Society is an article on the subject by Mr. J. Evarts Greene.

He makes the revolutionary suggestion that our government should scrupulously keep its promises to the Indians (!) and then proclaim them minors, keep their property and spend it for them as we see fit.

This latter item we will all gladly undertake; but the former is so totally without precedent that it sounds anarchistic! Are we, because of some short-sighted promise of our fathers, to allow the savage to impede the glorious march of civilization in this great western world? Never!

In the discussion President G. Stanley Hall rather timidly advanced the suggestion that if the Indian is met 'in a sympathetic way' he might develop his own civilization. As if our noble and active youth had time to 'sympathize' with the 'gray barbarian,' when the manifest destiny of the youth is to amass a fortune and live abroad!

Independence and land in severalty form the only honorable platform, and, as we grant that to white, yellow and black citi-

zens, why draw the line at the color red? Secular education, and not mere Sunday-schooling, will teach them to use this independence aright.

ANTHROPOLOGY OF FRENCH POLYNESIA.

WE scarcely ever hear about the French possessions in Polynesia. The tri-color in fact floats over a number of coral islets and pocket archipelagoes in the benign climes of the Pacific sea. The most important spots are Tahiti and the Marquesas group. The anthropology of these islands is discussed by Dr. Gros, of the French navy, in the Bulletins of the Anthropological Society, Paris, of this year.

After giving a number of measurements he discusses several questions of general interest. Is the native population decreasing, and why? It is decreasing, not very rapidly, and owing mainly to mortality from epidemics, which this brown race has little power to resist. They are, moreover, great drunkards, and this predisposes them to disease.

Are they capable of culture development? Decidedly so, thinks Dr. Gros. Before the arrival of the whites they had made steady and considerable progress, and when given an opportunity readily acquire and use modern education. The teacher is the person needed in Polynesia. Divorces are frequent and social morality low. Much of this is owing to the example and influence of Europeans. The race is rapidly becoming of mixed blood from crossing with foreigners of different nationalities who visit the islands.

THE LATE DR. A. H. POST.

IT would be difficult to name any writer in this generation whose conception of the science of Ethnology was so profound and noble as that of the late Dr. A. H. Post, of Bremen. He understood that science in its broadest connotation, and clearly recognized in it that branch of learning which in the not distant future will modify all others, changing their direction and altering their contents. He saw that ethnology is bound completely to subvert the present popular *Weltanschauung*, and substitute for it another with scarcely any points of contact.

Post's especial field was that branch of Ethnology which deals with the ideas of rights and equities, the treaties and duties of man to man, in other words, jurisprudence in its largest meaning. On this he wrote a number of articles and treatises, the most important being his 'Grundriss der ethnologischen Jurisprudenz,' published but a few months before his death. This is a work which combines extraordinary minuteness of detail with equally extraordinary grasp of principles, and sets forth the elements of Ethnology as a (one might almost say, *the*) universal science through one of its branches.

Dr. Post's friend and admirer, Dr. Th. Achelis, has just published an appreciative tribute to the departed thinker. It sets forth briefly the aim and spirit of his work and should be taken to heart by all who have learned to know this great, new growth of man's intelligence (A. H. Post und die vergleichende Rechtswissenschaft. Hamburg, 1896).

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UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

A PAPER was recently read before the Royal Society of New South Wales by Prof. Liversidge, of the University of Sydney, on the amount of gold and silver in sea water. Heretofore it has been considered that the amount of gold present is about four grains per ton. The experiments of Prof. Liversidge show that for Australian waters this figure is too large, the amount being from one-half to one grain of gold per ton of sea water. Even this would be in round numbers about 200 tons of gold per cubic mile,

and if the volume of the ocean be considered 300,000,000 cubic miles, a total amount of gold in sea water of sixty billion tons. Yet this amount is probably insignificant in comparison with the amount of gold disseminated in crystalline and sedimentary rocks apart from gold in veins and other deposits. Experiments seem to indicate that sea water contains about the same amount of silver and gold.

Prof. F. P. Venable's work on 'The Development of the Periodic Law' has just appeared from the press of the Chemical Publishing Company. It is a book of over three hundred pages, dealing exhaustively with subjects from the days of Dalton and Prout down to the present year, and covering a phase of chemical history hitherto vacant.

On October 1st appeared the initial number of a new periodical in chemical technology, the *Chemische Rundschau: Zeitschrift für die gesammte chemische Industrie.* It is a quarto of twenty-four pages, to appear semimonthly, at sixteen Marks per year. Its editor is Dr. Franz Peters, assistant at the Technische Hochschule at Charlottenburg, and it is published in Berlin. The first number contains several pages of original matter, a rather larger number devoted to abstracts, and quite full trade notes, together with book reviews, society proceedings and patent lists.

The idea suggested by Prof. Ramsay in connection with his work on Helium, that it is possible that all atoms of the same chemical element do not possess exactly the same weight, and which was also suggested by Prof. Crookes in connection with his work upon the rare earths, is by no means new. Before Stas entered upon his great work on atomic weights he raised the question as to whether these weights were unchangeable, but after experiment decided it in the affirmative (Stas: Untersuchung über die Gesetze der chemischen Proportionen, etc. Deutsch von L. Aronstein, Leipzig, 1867, p. 3). Again in 1883, working on the analysis of Caucasian petroleum, Schützenberger was unable to explain certain quantitative anomalies in the amount of carbon dioxid obtained, and Butlerow proposed as a most probable cause a variation in weight of the carbon atom (Bull. Soc. Chim., 39: 258, 263). This question has also been discussed on theoretical grounds by Marignac, Kremers and Cooke. Prof. Ramsay's promised experiments on the fractional diffusion of oxygen and nitrogen through clay septa will be awaited with interest as a valuable contribution to the subject.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

A BUILDING FOR THE SCIENTIFIC SOCIETIES OF NEW YORK.

Mr. Charles F. Cox, Treasurer of the New York Academy of Sciences, has addressed a letter to the editor of the *Evening Post* appealing to a man of wealth or a group of men to provide a suitable building for the societies composing the Scientific Alliance of New York.

The counsel of the Alliance was last year incorporated under a charter which gives it power to receive gifts and bequests and to hold real estate for the benefit of the organizations which it represents. The combined membership of these societies is now over 1,000. Nearly all of them issue valuable publications; several of them own important libraries and growing collections of specimens, and all are actively engaged in original research as well as the popular presentation of scientific topics.

The societies suffer from lack of a suitable building similar to that of Burlington House, London, but in New York this can only be provided by the enlightened liberality of private citizens. The proposed building should be located in the center of the city, and should be large enough to contain: a lecture-hall having a seating capacity of not less than 1,200, in which free popular lectures could be given frequently; a library with shelf-room for not less 100,000

volumes, in which should be formed a model collection of works of reference in every department of science; a meeting-room to accommodate say 250 persons, in which the ordinary sessions of the several societies would be held; a smaller room for each of the constituent organizations, in which its private records and papers might be kept and where its committee meetings could be held and other detail work performed; and finally a few small laboratories and a photographic room for the common use of all members.

SPECIALISM AT THE BRITISH ASSOCIATION.

THE forthcoming number of *Natural Science* will contain a timely protest against the presentation of trivial papers, or of technical papers that should be printed rather than read, at meetings of the British Association. The editorial article continues: "Of course, the wise man does not go to hear these papers; he knows that many of them are read for the sake of self-advertisement, and that any which are of value will soon be accessible through the ordinary channels of publication. For all that, it seems well to protest, if only in the hope that our words may reach the Canadian cousins who are preparing so splendid a welcome for the Association next year. These papers not merely clog the work of the sections, but have an effect directly contrary to the main object of the Association. Some, perhaps, read by local naturalists, or descriptive of local phenomena, to which the attention of visitors should be directed, are not to be discouraged, but the rest both frighten away the people whom the Association wishes to attract, and, what we feel to be of more importance, tend to split the scientific visitors themselves still further among sections. The Association should rise above the specialism of most of our learned societies; it should offer a field where the zoologist might confer with the botanist, where both might exchange experiences with the geologist, and where all three might pick up something of use to them from the physicist and chemist, who in their turn need not go the poorer away. Let there be more discussions on matters of general interest, and let them be thrown open to even more sections. Why, for instance, should the discussion of Neo-Lamarckism have been confined to zoologists? Surely some of the physical problems that were hinted at in the discussion on the cell might have been laid before the physicists."

GENERAL.

FOLLOWING on the death of Ferdinand Baron von Müller the death is announced of Dr. Henry Trimen, who occupied a position in Ceylon somewhat similar to that held by Müller in Australia. Trimen died on October 16th, at Peradeniya, at the age of fifty-two. Before leaving England he had been curator of the anatomical museum of King's College and senior assistant of the botanical department of the British Museum. He edited the *Journal of Botany* from 1872 to 1879. In 1880 he was appointed director of the Royal Botanic Garden at Ceylon. He made numerous contributions to our knowledge of the flora of the island, and introduced into cultivation many useful products from foreign countries.

DR. GEORGE HARLEY, a distinguished English physician and versatile writer, died in London on October 27th.

PROF. L. L. DYCHE, of the University of Kansas, has returned from Alaska, where he has explored Cook's Inlet and the Knik river, and has obtained many valuable zoological specimens.

A SERIOUS explosion occurred in Paris on October 17th. A tube containing acetylene exploded and the building used by M. Raoul Pictet, the well known chemist, for the manufacture of acetylene was entirely destroyed.

IT is announced in *Nature* that the following have been nominated by the Council of the London Mathematical Society for election as the Council and officers for the ensuing session: President, Prof. Elliott, F. R. S.; Vice-Presidents, Major Macmahon, R. A., F. R. S., M. Jenkins and Dr. Hobson, F. R. S.; Treasurer, Dr. J. Larmor, F. R. S.; Secretaries, R. Tucker and A. E. H. Love, F. R. S.; other members, Lieut.-Col. Cunningham, R. E., H. T. Gerrans, Dr. Glaisher, F. R. S., Prof. Greenhill, F. R. S., Prof. Hill, F. R. S., Prof. Hudson, A. B. Kempe, F. R. S., F. S. Macaulay and D. B. Mair. At

the annual general meeting of the Society, which will be held on November 12th, Major Macmahon will take as the subject of his valedictory address, 'The Combinatory Analysis.' On the same evening the De Morgan medal will be presented to S. Roberts, F. R. S., who will be the fifth recipient of the medal.

According to the authorized announcement of the University of the State of New York, Prof. W. M. Davis, of Harvard University, has been invited to prepare, for publication and distribution in the New York schools, a pamphlet, similar to that prepared for the State of Connecticut, as an aid to the more interesting and profitable study of geography. Prof. Davis has also consented to speak at the next University convocation on the present trend of the study of geography.

The will of the late Sir John Erichsen bequeaths to University College his surgical instruments and appliances, and to University College Hospital £2,000 for the rebuilding fund exclusively.

The thirty-sixth annual meeting of the National Educational Association will be held in Milwaukee during the first week of July of next year.

We learn from *The Lancet* that the new Pathological Institute, which has been erected in the grounds of the Western Infirmary, Glasgow, was formally opened on the 14th inst. The institute comprises a large lecture room, post-mortem laboratory, practical class room, chemical and bacteriological laboratories, photographic room and private working rooms, in which original researches may be conducted, as well as a large and commodious museum. The total expenditure has exceeded £15,000. At the inaugural ceremony Prof. Gairdner delivered an address on the relation of the study of pathology to the art of medicine and the public health. Speeches were also delivered by Prof. Coats, Prof. Boyce (Liverpool), Dr. Leith, (Edinburgh), Mr. J. G. A. Baird, M.P., and Mr. J. Wilson, M.P.

It is announced that The Yerkes Observatory will be ready for dedication and occupancy by the middle of the present month. The first bulletin of the observatory giving an account of its organization has already been issued. The bulletins will be published regularly and will contain announcements of new discoveries, and of the work of the observatory. There will also be published, under the title 'Contributions from the Yerkes Observatory,' papers contributed to various journals; and in quarto volumes 'Annals of the Yerkes Observatory,' containing accounts of research. The *Astrophysical Journal*, published by the University of Chicago, is now in its third volume and has maintained a high position as an international journal devoted to astro-physics and spectroscopy.

The foundation stone of the Marine Biological Station, Firth of Clyde, was laid on the 18th of last month by Dr. Thomas Reid, who has given £500 toward the building fund. The site was given by the Marquis of Bute.

A new laboratory of bacteriology has been established at the University of Pennsylvania by the State Live Stock Sanitary Board, in connection with the veterinary department. The purpose of this is to study all diseases connected with poultry and cattle. Dr. M. P. Ravenel, of the medical faculty, has been made director and bacteriologist.

D. Appleton & Co. announce the early publication of the completion of Herbert Spencer's system of philosophy. As first stated, this division of the *Synthetic Philosophy* was to be treated in two volumes, but in their preparation the amount of matter grew to such proportions that a third volume became necessary. It contains: Part VI., Ecclesiastical Institutions; part VII., Professional Institutions, and part VIII., Industrial Institutions.

Among other forthcoming books we notice 'Charles Darwin and the Theory of Natural Selection,' by E. B. Poulton (Cassell); 'An Autobiography of George Biddell Airy, Astronomer Royal from 1836 to 1881,' edited by Wilfrid Airy (Cambridge University Press), and 'Ancient Volcanoes of Britain,' by Sir Archibald Geikie, F. R. S., two volumes, illustrated (Macmillan).

A house divided against itself:

"I am much mistaken if the scientific spirit of the age is not doing us a great disservice,

working in us a certain great degeneracy. Science has bred in us a spirit of experiment and a contempt for the past. * * * We have made a perilous mistake in giving it too great a preponderance in method over every other branch of study."—Professor Woodrow Wilson, in the official oration at the Princton Sesquicentennial. "Religious themes must be discussed in a scientific spirit and according to scientific principles."—President Patton in the official sermon.

BACTERIOLOGY is probably the newest of the sciences, but germs and animalculæ have for centuries been regarded as possible causes of disease. The *Lancet* makes the following curious quotation from the 'Life of Aly Pasha,' who was Governer of Janina about the beginning of the century: "'That man,' continued Aly, 'is one of those who see in the dark. Would you believe it? He pretends that the plague is composed of a vast number of minute animalculæ, which would be visible through a magnifying glass, if one could be procured of sufficient power.'"

Appleton's Popular Science Monthly for November contains, as usual, a number of interesting articles. Among them may be mentioned an illustrated article by Dr. Bashford Dean reviewing the public aquariums of Europe, more especially those at Naples, Amsterdam, Plymouth, Paris, Berlin and Brighton. Prof. A. S. Packard contributes an article describing an ascent of of Mt. Shasta and a description of its crater. Prof. Harrison Allen publishes an address first delivered before the Academy of Natural Sciences, Philadelphia, describing the contributions to natural history made by Sir Thomas Brown and Sir Thomas Stanford Raffles. Prof. W. R. Newbold continues his interesting series of articles treating double personality. Prof. E. R. Shaw urges the employment of motor activities in teaching, and Prof. R. W. H. Hudson argues in favor of a natural moral standard. There is a sketch of William C. Redfield.

PROF. F. MAX MÜLLER'S translation of the Kant's *Critique of Pure Reason*, originally issued in 1881 in commemoration of the centenary of its first publication, has been reprinted with alterations by The Macmillan Company. As people seem more inclined to read books about literary and philosophical classics than the classics themselves, it is gratifying to find that there is a sufficient demand for a translation of Kant to warrant a new reprint in America. This must mean that there are many who read Kant, for it may be assumed that the great majority of those who care to read his works at all prefer to do this in the original. Prof. Max Müller has a perfect command of both German and English and effaces himself in the translation, not overburdening the text with philosophical or bibliographical notes. Kant was himself a man of science as well as a metaphysican, and while students of science are likely to find a certain insubstantiality in his *Critiques*, no one can read and understand them without securing a firmer foothold and a clearer outlook.

THE Open Court Publishing Company is performing a real service to science and philosophy by publishing, in excellent typography and at a low price, reprints of standard works. The last volume issued in the series, which is published bi-monthly at a yearly subscription price of $1.50, contains the English translation of Prof. Ernst Mach's *Popular Scientific Lectures*. Prof. Mach is one of those leaders in science who, like Helmholtz and Huxley, regards it as part of his service to interest the general public in scientific questions. These lectures when delivered must have attained their end to an unusual degree. As reprinted they are of somewhat unequal merit. So much progress has been made in physiological optics and acoustics during the past thirty years that lectures on these subjects written in the sixties are somewhat out of date. The polemic against the classics seems extreme. A judicial adjustment of claims is not forwarded by speaking of the 'narrow provinciality of mind' of the Greeks, or of 'Aristotle with his incapacity to learn from facts.' On the other hand, several of the lectures, such as the one on 'The Economic Nature of Physical Inquiry,' contain important contributions to scientific method.

WE take from the foreign journals the following details of the life of Moritz Schiff, whose death was recorded in the last number of this

JOURNAL. Schiff was born at Frankfort-on-Main in 1823, and was therefore 73 years of age. He studied medicine at Heidelberg (under Tiedemann), Berlin (under Johann Müller), and Göttingen. After taking his degree, he proceeded in 1845 to Paris, where he worked under Magendie and Longet. On his return to Frankfort he was appointed Director of the Ornithological Department of the Zoological Museum there. During the political disturbances in 1848 he served as a military surgeon on the Revolutionary side. His Liberalism practically closed the doors of the German universities against him, and he was refused a qualification as *Privatdocent* in zoology by the University of Göttingen on the ground that his teaching would be dangerous to the young. In 1854 he was appointed to the chair of comparative anatomy in the University of Berne, and this post he occupied till 1863, when he accepted an invitation to become professor of physiology in the Instituto degli Studii Superiori at Florence. There he remained till 1876, when he accepted an offer of the chair of physiology in the University of Geneva, which he held till his death. In January, 1894, Geneva celebrated the fiftieth anniversary of his medical doctorate and his pupils undertook to publish his researches in a special edition, the last volume of which was completed just before his death. These volumes show the great range and importance of Schiff's physiological researches. These, as is well known, were especially on the nervous system, but he also made important contributions to the physiology of digestion and of secretion. Earlier in his life he had published valuable contributions to ornithology. Schiff had been driven from Germany for his liberalism and from Italy on account of his experiments on living animals, though, as in the case of Ludwig, his treatment of these was always most kindly. His character, was not, however, affected by this treatment, and he was greatly beloved by his students and by all who knew him.

SEVERAL committees made reports in the department of meterology at the recent meeting of the British Association. The Committee on Meteorological Observations on Ben Nevis gave the details of the year's work. The observers have been investigating in past years the influence of cloud or fog and clear weather respectively on the daily fluctuations of barometric pressure. For these observations the directors have resolved to establish a temporary station, intermediate in height between the summit and the low-level station at Fort William. The report on solar radiation was presented, also that on seismological observations. The latter stated that, now that it had been proved that any important earthquake is felt all over the globe, the committee consider that arrangements should be made for the record and study of these movements. The committee believe that such records might prove as important as those of, *e. g.*, terrestrial magnetism, and, just as they had magnetic observatories in various parts of the world, so in its opinion should there be seismological ones. For the experimental work of the coming year the committee had one instrument, and could have the use of another (constructed under a grant to Prof. Milne by the Royal Society); it wished to purchase two others, and would have to build piers, etc., and pay for photographic necessaries and an assistant to run the instruments, which, altogether, would probably cost £200. In the report of the Committee on Meteorological Photographs full details were given of the method by which simultaneous photographs are taken, at two stations, 200 yards apart, of the same cloud in order to obtain the distance of the cloud from the observer. The sun is included in the photograph and serves as a reference mark in the measurements.

A CORRESPONDENT of the *N. Y. Evening Post* states that, to hold the new liquid fuel which is to be used hereafter in the German navy, large reservoirs holding over 100,000 gallons have been erected at Wilhelmshaven, and similar arrangements will be made at Kiel and Dantzic, a credit of nearly $45,000 having beer provided for this purpose in the last budget, besides $22,500 for pumping plant in connection with the basins. After various trials, the authorities have decided to fit all existing large men-of-war with apparatus for heating their boilers partly with oil, and the use of liquid fuel will be provided for in all new constructions.

UNIVERSITY AND EDUCATIONAL NEWS.

THE regents of the University of the State of New York will hereafter strictly enforce the law prohibiting the unauthorized use of the names college and university. An institution to be ranked as a college must have at least six professors giving their entire time to college and university work and a course of four full years of college grade in liberal arts and sciences, and must require for admission four years of academic or high school preparation in addition to the preacademic or grammar school studies. The regents believe it sound educational policy to encourage the establishment and maintenance of colleges wherever these minimum conditions can be met. The small college follows naturally the high school, and the more widely it is scattered about the country the better for higher education, but to give college instruction is a very different matter from exercising university powers in conferring degrees. The council earnestly recommended, as vitally important for protecting and promoting higher educational interests, that the regents should not, except for extraordinary reasons, increase the number of institutions in this State holding degree-conferring powers. Students completing the courses in colleges newly established may obtain from the university of the State the bachelor's degree, which will be more valuable and more widely recognized than a degree conferred by a local institution.

THE will of the late Miss Abby G. Beckwith leaves $5,000 to Brown University for the founding of two Scholarships.

THE first graduate of the University of Wales by examination is a woman, Miss Maria Dawson, B. S.

PROF. HOELDER, of Tubingen, has been appointed professor of mathematics in the University at Königsberg; Prof C. von Seelenhorst, of Jena, assistant professor in the University of Göttingen, and Dr. H. Stuhr, assistant in the Anatomical Institute at Breslau, in succession to Dr. Endres; Dr. Andreas Obrzut, of Prague, to the chair of anatomy at Lemberg. Dr. Joseph Blaas, of the University at Innsbrück, has been promoted to an assistant professorship of geology and paleontology.

DISCUSSION AND CORRESPONDENCE.

A REPREHENSIBLE METHOD OF DETERMINING PRIORITY OF PUBLICATION.

QUESTIONS of nomenclature and of priority of discovery in relation to matters of fact must, of course, be decided by the date of publication of the works in which the names of the species or the facts in question were first announced; hence it is important to determine the date of publication with the greatest possible definiteness. It is, therefore, necessary to define at the outset what is meant by the term publication. On this point the 'Century Dictionary' will be admitted as good authority. In this work the word publication, in the sense in which it is used in the present article, is defined as follows: "The act of offering a book, map, piece of music, or the like, to the public by sale or by gratuitous distribution." Publication thus implies distribution, and has no necessary relation to the date of printing, except that, of course, printing must precede publication.

Unfortunately, however, it is often difficult to determine the exact date when a book, pamphlet, or any regular part of a serial publication, or the signature of any work issued in signatures, became accessible to the public, or even to those especially interested in the subject to which the treatise relates; in a word, when it was *published*, or, to use the 'Century Dictionary' expression, *when it was offered to the public.*

We have only to look through the various codes of nomenclature for biology to find that the matter of determining the 'date of publication' has received attention from those who have made this question the subject of special consideration. The rule generally adopted by scientific bodies which have legislated on the subject is to the effect that the ostensible date, as that given on the title page of a book or pamphlet, or at the bottom of the signatures, when works are issued in signatures, shall be taken as the correct date, unless known to be erroneous, and that whenever such dates are found to be erroneous the true date of publication shall be taken in all cases where it can be established. The date of printing is thus wholly ignored as having any bearing on the

date of publication. Hence the long accepted date of some well-known work is liable at any time to be overthrown and some later or earlier date established as the real and proper date of publication, leading, of course, to great inconvenience and often to the overthrow of long accepted names.*

In view of the general unanimity of action on the part of naturalists on this question, it is a matter of surprise and deep regret that the Zoological Section of the American Association for the Advancement of Science should have recently adopted a set of resolutions wholly at variance with not only the concensus of opinion concerning 'the date of publication,' but with common sense; the only redeeming feature being the fact that they will fall harmlessly in consequence of their obvious absurdity. These resolutions were adopted at the Springfield meeting, held in August, 1895, and appear in the recently issued volume of the 'Proceedings' of the Association for that meeting (p. 159).† The whole pith of the resolutions is that 'the date of publication of books is the date at which they are printed.' This is the phraseology adopted in the second '*whereas*,' while the resolution covering this point is, in full, as follows:

"Resolved: *First*—The Section of Zoology of the American Association for the Advancement of Science recommends that the date of the completion of printing of a single issue be regarded as the date of publication.

"*Second*—That the Section recommends that such date be printed on the last signature of all publications, whether books, periodicals or 'separates.'"

The reasons given in support of this resolution show a surprising lack of familiarity with the subject in hand on the part of the framers of these resolutions; and it is not a little remarkable that they should have been adopted in such a body 'with but one pertinent objection,' as the editor of the *American Naturalist* states. The gist of the argument in favor of the above quoted resolution is given under the final '*whereas*,' as follows: "The determination of the date of printing will generally depend on the records of the printing office and the testimony of several persons, while the time of mailing will be known generally to but one person;" or, as said just previously, "the actual date of mailing will be often impossible to ascertain with precision, owing to lack of record and irregularity in the period of transmission."

While these allegations may be true, they have really no bearing on the question at issue, namely, the *date of publication*, as commonly understood.

The absurdity and mischievousness of this ruling may be easily illustrated. The U. S. National Museum has within the last few months distributed two 'Special Bulletins' bearing date 1895. These important quarto publications were *printed* in 1895; in one case the printing was completed six or eight months, and in the other nearly or quite a year, before any copies were distributed, or before these works were 'published.' In one of these a new genus of fishes was described, under a name which before the work was published was also given to a genus of birds. The paper in which the bird genus was described and named is dated and was distributed June, 1896, while no copies of the work in which the fish genus was described were distributed before Angust, 1896, as I am informed by one of the authors of the latter work. According to current usage, the generic name in question must stand for the bird genus, and the fish genus must be renamed. According to the 'resolutions' of the Zoological Section of the American Association for the Advancement of Science, the name must stand for the fish genus and the bird genus be renamed. This is only one out of many parallel instances that might be cited.

When, as often happens, a work appears from the Government Printing Office months or even years after it was printed and dated, it is obviously absurd to claim, when the facts in the case are known, that the work was published at the date borne on the title page, if it

*A case in point is the 'Proceedings' of the London Zoological Society, some parts of the earlier volumes being dated from three months to two years and a-half in advance of their delivery by the printer to the Society. *Cf.* Sclater (P. L.), Proc. Zool. Soc. London, 1895, pp. 435–440.

†They appear to have been first printed in this Journal for October 11, 1895 (N. S. Vol. II., pp. 477–8), and have been recently reprinted with editorial commendation in the *American Naturalist* (August, 1896, pp. 651, 652).

was not distributed and rendered accessible to the public till a long time after it was printed. Indeed, it has often happened that books have been printed, even under other than Government auspices, and held in storage for years before any copies were distributed. In the usual course of trade books are often printed and held in stock, for trade reasons, for issue on a certain date, which is recognized as the date of publication. On a certain fixed day, generally previously announced, the book is placed on the market, and the advance orders for it from booksellers and others are filled on that day, which, in the records of the trade, is the date of its publication. For this purpose books are often dated several months ahead of the time when they are printed, in order that the date on the title page may agree with the date of their issue.

These simple facts show clearly how little claim the date of *printing* has to be taken as the date of *publication*, as advocated in the resolutions here under notice. If the same effort were made to find out the real date of distribution that is contemplated in these resolutions as necessary to establish the date of printing, the result would probably be worth the labor expended, for we should then be placed in possession of the real date of publication. How and by whom this needed work is to be done might form a subject worthy of consideration by even the Zoological Section of the American Association for the Advancement of Science.

J. A. ALLEN.

AMERICAN MUSEUM OF
NATURAL HISTORY, NEW YORK.

SCIENTIFIC LITERATURE.

Geological Survey of New Jersey. Annual Report of the State Geologist (John C. Smock) *for the Year 1894:* Trenton, 1895. Pp. 303, Plates I–XI, fig, 1. One map in pocket.

In the first paper of the volume before us, entitled 'Part I., Surface Geology,' Prof. Salisbury continues the record of his observations on the surface deposits of the northern part of the State, that is, of that portion which lies within or near the terminal moraine. For about one hundred pages the reader will find a valuable record of phenomena, which furnish a basis for subsequent deductions and which are of local importance, both to residents of the district and to visiting geologists. These pages deal with the drift deposits north of the moraine, taking them up under three different areas, viz., (*a*) drift deposits west of Green Pond Mountain, (*b*) drift on the Bearfort, Kanouse, Green Pond and Copperas Mountains, (*c*) drift east of the Green Pond Mountain range. Under each the unstratified drift, till or ground moraine is first described, and then the stratified. The former is chiefly on the mountains, the latter in the valleys. The glacial striæ next receive attention and from about 380 recorded observations it is shown that, as a rule, on the Palisade ridge the ice moved east of south, while west of it the direction is west of south. There are some cases of intersecting striæ and some minor local variations, but the above is the rule. The topics of changes in drainage and lakes are next discussed. The former are insignificant and of the latter the important cases are mostly due to obstructions of drift across streams. The post-glacial changes within the glacial area occupy Section IV. The post-glacial erosion is shown to be small, and the remaining topics—the alluvial deposits, peat and marl, and the changes of level—present little of great moment, except that under the latter the changes of level in the shore lines of Lake Passaic indicate post-glacial deformation in this region.

The remainder of Prof. Salisbury's paper is occupied with the surface formations south of the terminal moraine. The one earlier called the Beacon Hill is first discussed and is correlated with considerable certainty with Dr. W. B. Clark's Miocene beds farther south. The overlying Pensauken formation is considered as an equivalent of the Lafayette, and the still later Jamesburg is made the representative of the Columbia. Surface formations of even later date are briefly cited. A few pages are devoted to road materials and then in the concluding section the author describes the large map that accompanies the report. This exhibits the surface formations over the northeastern portion of the State in as great detail as has ever been attempted for an American area. Thirty different signs appear on the map, a number that

will emphasize at once the refinements in distinctions of glacial deposits that have been adopted.

The second paper of the volume is by Lewis Woolman and continues the important records of artesian wells, that the same writer has contributed to earlier reports. A moment's reflection will convince the reader, that the problem of water supply in the towns of the flat country of southern New Jersey is a serious one. The surface relief is slight and natural head is not available. Artesian wells have been developed with marked success, and, thanks to the careful records of Mr. Woolman, the productive horizons are now well identified. There are six in Miocene strata, of which one, the lowest exceeds the others in productiveness. There are four in the Cretaceous, all large producers. The remaining ones are less uniform and embrace Quaternary sands and gravels, Triassic sandstones and even Archean metamorphic rocks. Mr. Woolman discusses the several geographical areas of the state, and gives many sections and lists of fossils from borings, of which those of diatoms are particularly complete. The report contains a great deal of matter important in connection with water supply, but no less valuable as regards general geology.

The next paper is a Report on Forestry, by C. C. Vermeule and John Gifford. This is divided into a final report on the northern portion of the state by Mr. Vermeule and a preliminary one on the southern by Mr. Gifford. Many interesting topics are discussed and a good forestry map is appended. For the general reader the pages of the latter report that deal with the swamp cedar industry and the resurrection of old and buried logs will prove especially interesting.

The usual mineral statistics of iron ore and zinc ore conclude the volume. Of the former there were mined in 1894, 277,483 tons, a falling off of over 75,000 tons from the production of 1893. Despite this fact New Jersey was eighth on the list and outranked New York, whereas with the larger production of 1893, she was only ninth. The zinc ore raised was 55,582 tons, a falling off from 1893 of nearly 22,000 tons.

The report before us approaches very nearly to what we conceive to be the proper scope of a geological report for one of our older States. It gives, as the reports of New Jersey have given for many years, a large amount of material that the average taxpayer can appreciate and use. At the same time, as much pure science is introduced as may be wise and safe from the administrative point of view.

J. F. Kemp.

Demon Possession, and Allied Themes. By Rev. John L. Nevius, D. D. With an introduction by Rev. F. F. Ellinwood, D. D. Second Edition, pp. 520. F. W. Revel Co., New York. 1896.

The late Rev. Dr. Nevius was for many years a missionary to China, and while there had a number of opportunities to witness or to learn about cases of mental disease which, he became convinced, could not be ascribed to natural causes, but were the result of demonic possession, or the entrance into a man of an alien evil spirit.

In this work he describes a number of such instances and then discusses the naturalistic explanations which have been offered, especially the pathological and the psychological theories. Both of these he rejects, and prefers the 'biblical' theory of demonic possession. He argues that no other explanation is either consistent or proper as applied to the cases recorded in the Gospel, and if they are to be literally understood as of supernatural origin there is no reason why those wholly analogous in course and symptoms which he describes should not also be so regarded.

Against this argument little can be said by one who concedes the premise; but modern psychology does not. It explains the phenomena of the human mind by the ascertained laws of the human mind, and does not grant that any other explanation is necessary. Let us apply this reasoning in the present instance.

Facts such as Dr. Nevius brings forward belong to the most common of irregular mental phenomena. Such seizures are extremely frequent in the Shamanistic cults of savage tribes. They are cited by the hundred among Australian blacks, American Indians and African Negroes. Bishop Calloway, formerly of the diocese of Natal, says that nearly all his converts

among the Zulus suffered from them for a few years after conversion. They are identical with the 'ecstasy' and prophetic 'manteia' (*i. e.*, mania) which played such a large part in the orgiastic rites of Greece and, indeed, of the whole ancient world. The human soul was everywhere regarded as a gift of, or akin to, the Divine, and in its nature, prophetic; so that when, in these moments of strange emotion, it spake with tongues and entered into rapt communion with the Spirit, it simply expressed its true nature and noble origin.

Christianity, which taught that 'the gods of the heathen are devils,' changed the meaning of *daimon* from a beneficent guardian to a diabolic imp, and called the inspiration of the Pythoness a 'possession by the devil.'

Psychology, unable to recognize the god as the devil in these attacks, sees in them the emotional outbreaks of the sub-liminal consciousness, examples of pathological psychic automatism, occurring always in weak or weakened minds, excited by auto- or collective suggestion, limited always by the boundaries of the individual mind itself, never in any proved instance exceeding its powers, though sometimes seeming so to do, owing to deficient observation on the part of the observer. The proof of the correctness of this position is that experienced alienists never see a case of demonic possession. Their arrival is as certain to dispel it as is, according to Dr. Nevius and many other good men, the 'sacred name' itself. What the alienist sees is hysteric or epileptoid convulsions, or emotional contagious mania, and the like; and this is all that any one will see who carefully studies such conditions.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

Naual oder die Die Hohe Wissenschaft der Architectonischen und Künstlerischen Composition bei den Maya-Völkern deren Descendenten und Schülern. By A. EICHHORN. Berlin. 1896. Pp. 1–126.

It seems the time has not yet come when it will be understood that the treatment of anthropological problems requires as much training and knowledge as work in other branches of science; else a book like the present would not have been published with any serious pretensions. The scientific method of the author is sufficiently characterized by the naïve etymology of meander from the Maya word *mai*, hand, and *andros*, genitive of *ἀνήρ*, *i. e.*, a man's hand. His other etymologies are of the same value. The author treats words in the most arbitrary manner, changing the order of sounds and syllables, and fits this material to fanciful theories on a heoric language of the Mexicans, and to no less fanciful interpretations of sculptures. As a scientific contribution the work is of no value.

F. BOAS.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES, SECTION OF GEOLOGY AND MINERALOGY, OCTOBER 19.

THE first paper of the evening was by Arthur Hollick, entitled 'Geological Notes; Long Island and Block Island.' Previous investigations on Staten Island, Long Island, Martha's Vineyard and Nantucket have proved a unity of geologic conditions throughout, and it was confidently expected that a careful examination of Block Island would show this also to be part of the same general series. During the past summer the island was visited and proofs were obtained of drift phenomena, identical with those of the other localities. A collection of fossils was made which demonstrated the former existence of cretaceous strata on the island. The material collected consisted of plant remains, imperfectly preserved and of mollusks in a good state of preservation. These latter were identified by Prof. R. P. Whitfield and the list numbers ten species, in addition to fragmentary remains of perhaps half a dozen more. They are typical of the lower greensand marl and were found as drift material in the moraine, under the same conditions in which similar fossils have been found in the other localities mentioned. It was also thought advisable to visit again the eastern end of Long Island in order to ascertain whether more definite fossil remains could be found on Montauk Point, where imperfectly preserved fossils had been discovered on a previous occasion. Here also well preserved mollusks were found, likewise identified by Prof. Whitfield, who has

furnished a list of five species and two genera, in addition to which were a number of imperfect specimens, representing about five additional species. The discoveries were highly satisfactory, and furnished the proof that had been confidently expected. The specimens collected were exhibited.

The second paper was by Prof. J. F. Kemp on the Glacial or Post-Glacial Diversion of the Bronx river. The speaker showed that the Bronx river from its source to Williamsbridge follows an old valley, excavated in limestone. This valley continues from a point below Williamsbridge to its end, on the Sound opposite Randall's island and there is a depression the entire distance. Just below Williamsbridge, however, the river turns from its old valley and breaks through a ridge of enclosing gneiss on the east. It has excavated a gorge about 70 feet deep, with large fresh pot holes remaining on the sides, respectively at altitudes of 20 and 50 feet above the stream. The maximum height of the divide between the present channel and the older one is only 10 to 15 feet. The speaker found difficulty in accounting for the diversion, in that no barrier of gravel or other deposit is visible along the line of the old channel, which would turn the stream from this across the high ridge in which is the gorge. The freshness of the pot holes indicated that the stream had cut the gorge during the glacial times and since then. He therefore referred the diversion to the ice of the continental glacier a lobe of which must have filled the earlier channel. It is probable that the early excavation was done by a sub-glacial stream, heavily loaded with sediment.

The third paper of the evening was by D. H. Newland on the Eclogites of Bavaria. The speaker described the extent and mineralogy of the rocks and his attempts to discover their unmetamorphosed originals. Chiefly on chemical analysis he was led to infer that they had been originally diabases or gabbros.

J. F. Kemp, *Secretary.*

SECTION OF ANTHROPOLOGY, PSYCHOLOGY AND PHILOLOGY, OCTOBER 26, 1896.

The Academy met with Prof. F. H. Giddings in the chair. The Sub-section of Psychology and Anthropology immediately organized and the following papers were presented:

J. McK. Cattell, 'On Physical and Mental Measurements of Students of Columbia University.' This paper described the results of a series of tests that has been made in conjunction with Dr. Farrand on students of Columbia University during the past two years. The members of the Freshmen class were requested to come to the psychological laboratory, where their physical, psycho-physical and mental traits were tested. An hour was given to each student, 10 records and 26 measurements being made. The tests selected, the methods of making them, and the results were described. Special stress was laid on the value of such work in the study of development and of the correlation of physical and mental traits. The paper will appear in full in the current (November) number of *The Psychological Review.*

Franz Boas, 'On the Limitations of the Comparative Method in Anthropology.' This paper will appear in full in an early number of Science.

Livingston Farrand,
Secretary of Sub-section.

NEW BOOKS.

A Popular Hand-book of the Ornithology of Eastern North America. Thomas Nuttall. Second revised and annotated edition by Montague Chamberlain. Boston, Little, Brown & Co. 1896. Vol. I., liv+473; Vol. II., xi+431.

A-Birding on a Bronco. Florence A. Merriam. Boston and New York, Houghton, Mifflin & Co. Pp. x+226. $1.25.

Hand-book of Courses Open to Women in British, Continental and Canadian Universities. Isabel Maddison. New York, The Macmillan Co. 1896. Pp. iv+155. 50 cts.

The Elements of Electro-Chemistry. Max C. Blanc. Translated by W. R. Whitney. London and New York, The Macmillan Co. 1896. Pp. x+284.

Transactions of the American Climatological Association for the Year 1896. Vol. II., The Report of the Committee on Health Resorts. Philadelphia. 1896. Pp. xxviii+293.